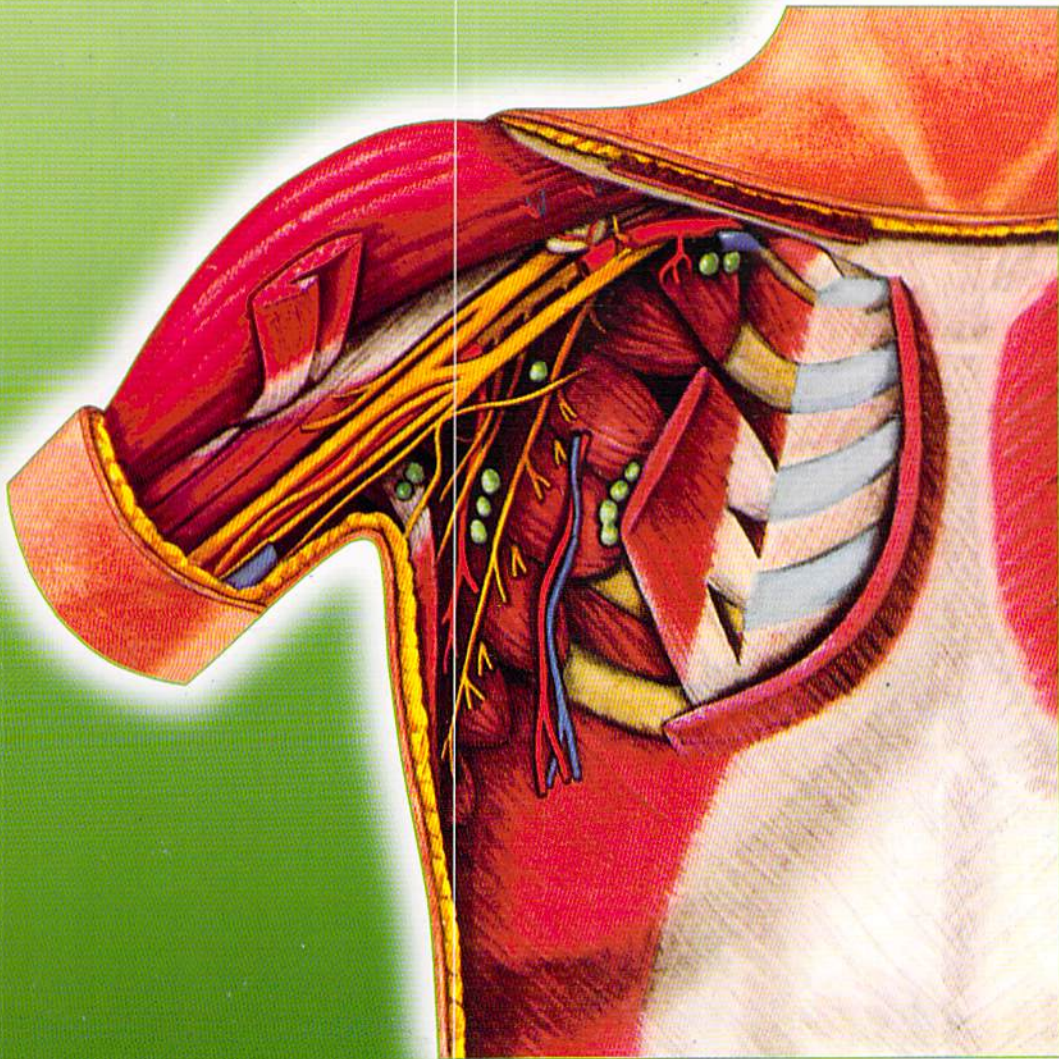


Anatomy Hand-out

UPPER LIMB



By

DR. SAMEH DOSS (Ph.D)

PROFESSOR OF ANATOMY

FACULTY OF MEDICINE, CAIRO UNIVERSITY

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anatomy hand-out

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Anatomical abbreviations

Rt. = right

a. = artery

v. = vein

n. = nerve

m. = muscle

ant. = anterior

med. = medial

sup. = superior

L.N. = lymph node

Lig. = ligament

flex. = flexor

abd. = abductor

N.S = nerve supply

U.L = upper limb

C. = Cervical

L. = lumbar

br. = branch

Lt. = left

aa. = arteries

vv. = veins

nn. = nerves

mm = muscles

post. = posterior

lat. = lateral

inf. = inferior

L.Ns = lymph nodes

Ligs. = ligaments

Ext. = extensor

add. = adductor

// = inch (2.5cm.)

L.L. = lower limb

T. = thoracic

S. = sacral

brs. = branches

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Bones of the Upper Limb

1

The bones of the upper limb consist of :

(I) Bones of the shoulder or pectoral girdle :

these are the bones which connect the upper limb to the trunk and include :

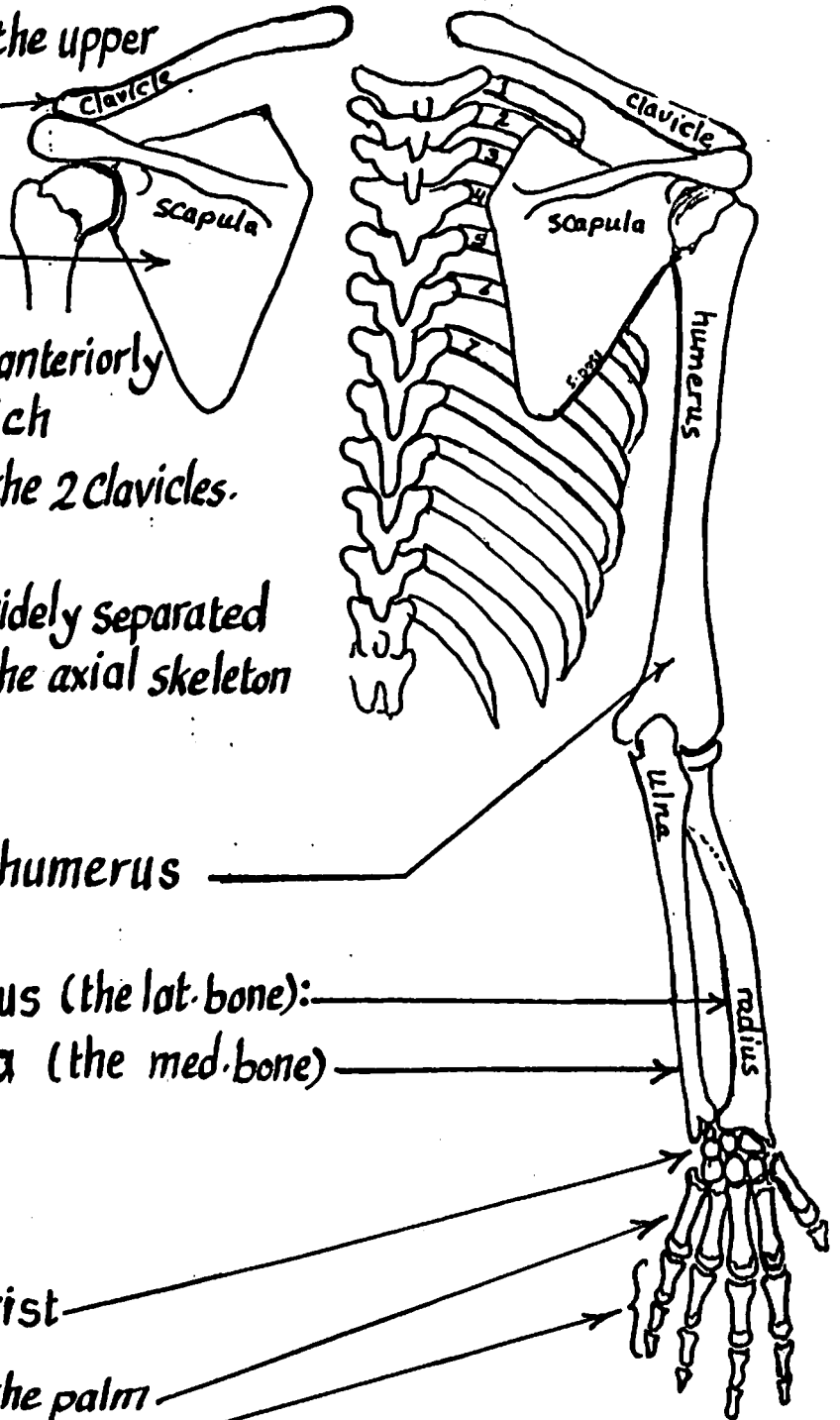
(a) the Clavicle : anteriorly

(b) the scapula : posteriorly:

N.B:

(1) the shoulder girdle is completed anteriorly by the upper end of the sternum which articulates with the med. ends of the 2 clavicles.

(2) posteriorly, the 2 scapulae are widely separated from each other & are connected to the axial skeleton by muscles only.



II- Bone of the upper arm: the humerus

III Bones of the forearm : (1) Radius (the lat. bone):

(2) ulna (the med. bone)

IV- Bones of the hand: include :

(a) Carpal bones : present in the wrist

(b) metacarpal bones : present in the palm

(c) phalanges : present in the fingers

(1) THE SCAPULA

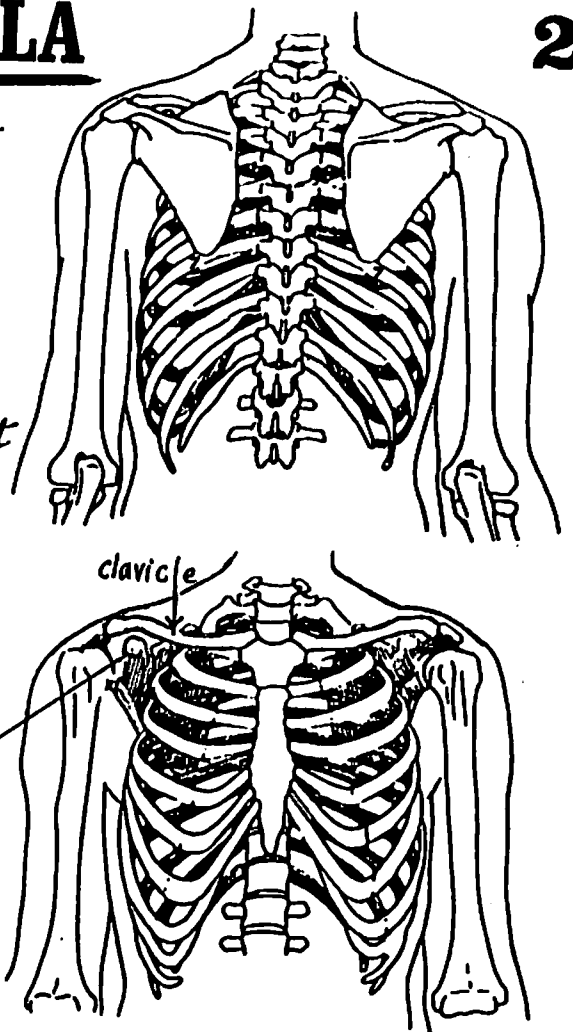
2

* It is the post. bone of the shoulder girdle.

* Type: it is a flat bone developing by cartilagenous ossification.

* Anatomical position:

- (1) it lies on the posterolateral aspect of the chest wall covering the backs of the ribs 2-7.
- (2) its med. border lies parallel to the vertebral column & 5 cm. away from the spines.
- (3) its surfaces lie in a plane midway between front to back & side to side.
- (4) the coracoid process projects forwards & slightly laterally below the junction between the lat. $\frac{1}{4}$ & the med. $\frac{3}{4}$ of the clavicle.



I-- GENERAL FEATURES OF THE SCAPULA

the scapula has:

- (a) 2 surfaces : ant. & post.
- (b) 3 borders : sup, med. & lateral.
- (c) 3 angles : sup, inf. & lateral.
- (d) 3 fossae : subscapular, supraspinous & infraspinous.
- (e) 3 processes : spine, acromion & coracoid process.
- (f) 3 notches : suprascapular, spinoglenoid & circumflex scapular.
- (g) 3 tubercles : supraglenoid, infraglenoid & tubercle of the spine.

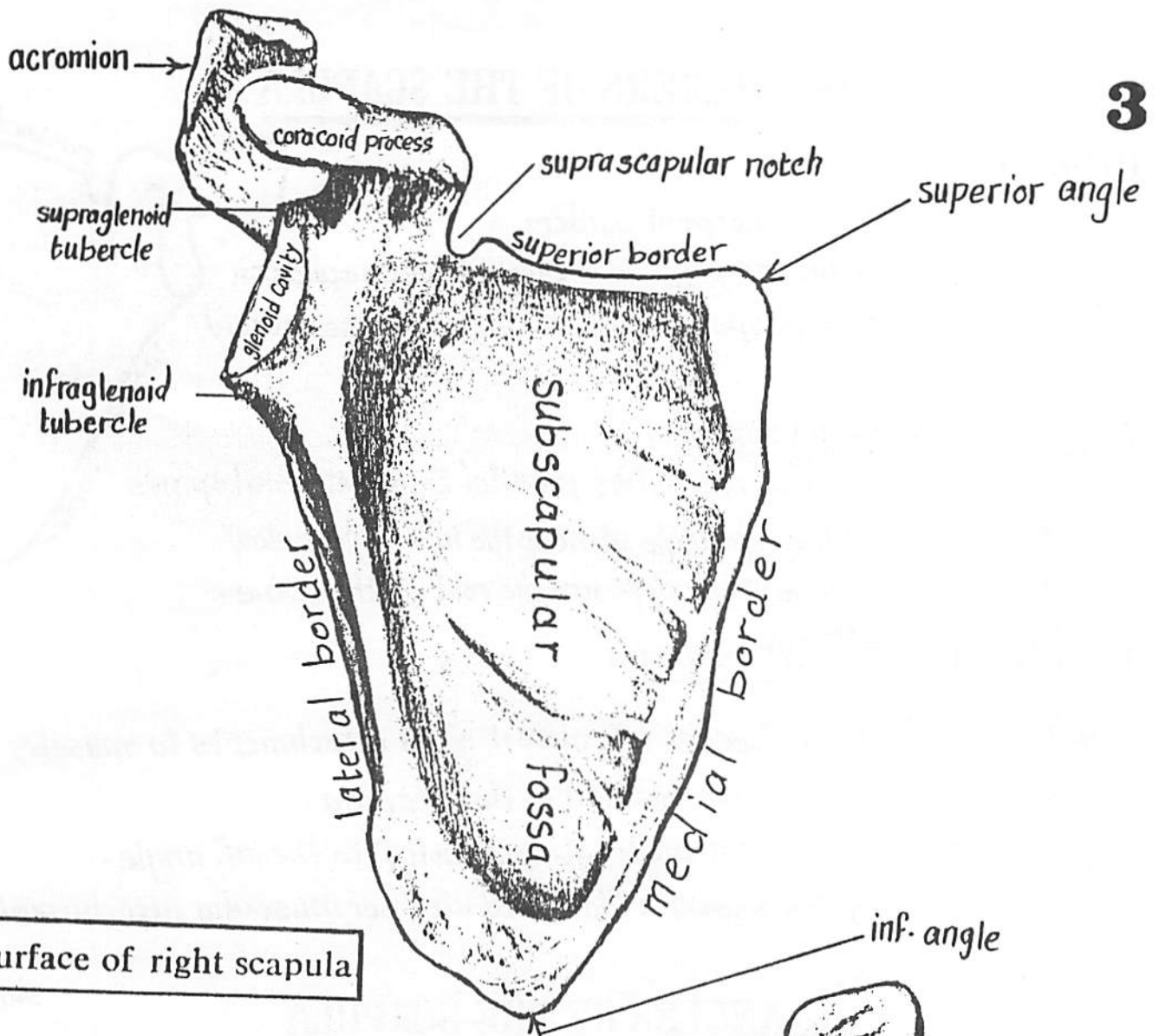
(A) SURFACES OF THE SCAPULA (2)

(1) Costal Surface (anterior or ventral) :

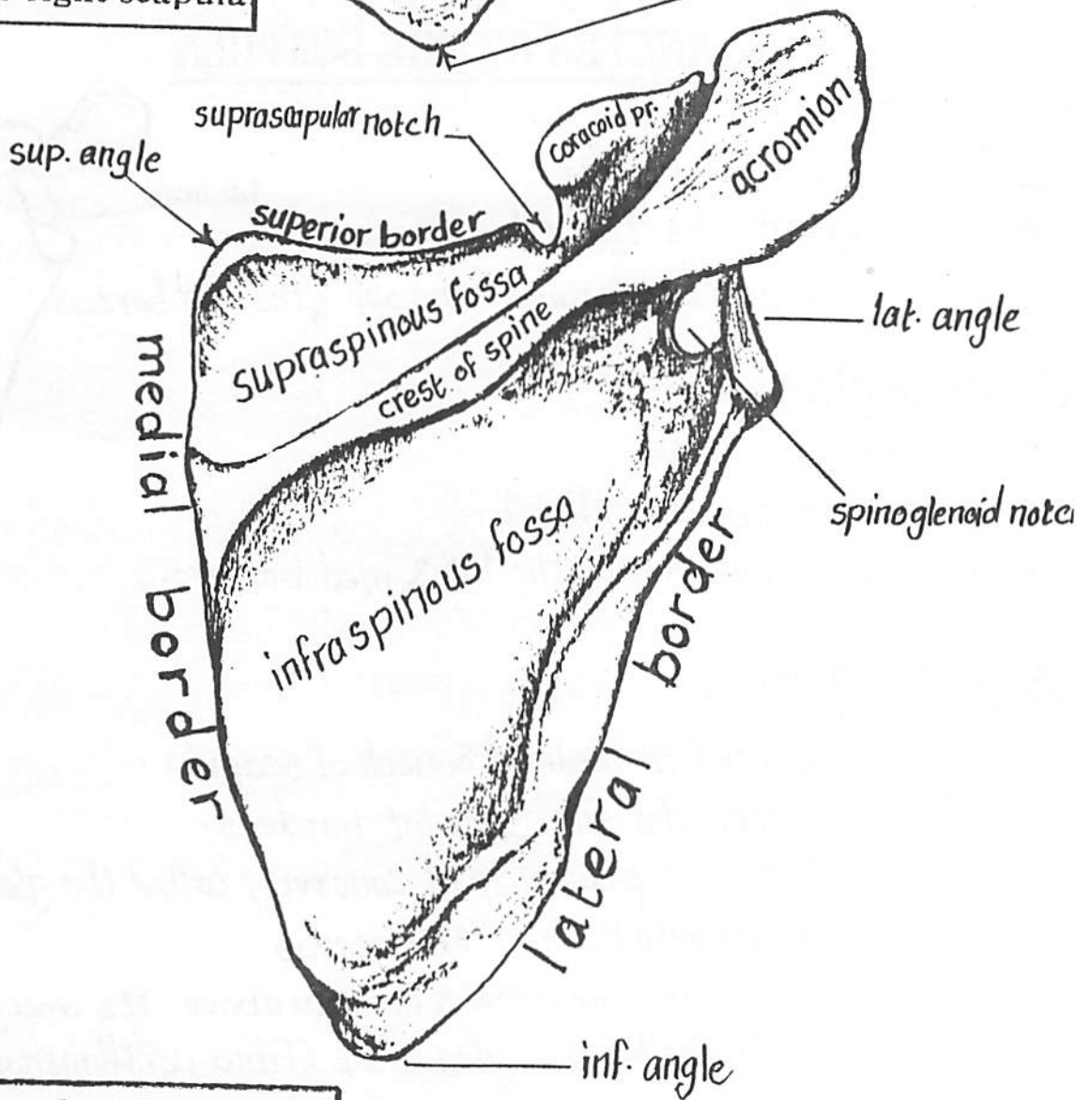
- * it is slightly concave forming the subscapular fossa.
- * it is directed forwards & medially.

(2) Dorsal (posterior) surface :

- * faces backwards & laterally.
- * it is divided by the attachment of the spine into a small supraspinous fossa above the spine & a large infraspinous fossa below.



Ventral surface of right scapula



Dorsal surface of right scapula.

(B) BORDERS OF THE SCAPULA

(1) Superior border:

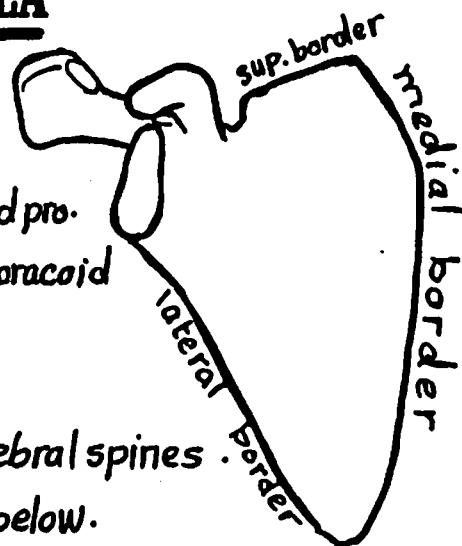
- * it is the shortest & sharpest border.
- * it extends from the sup. angle to the root of the coracoid pro.
- * it presents a supra scapular notch near the root of the coracoid process.

(2) medial (vertebral) border:

- * it is the longest border & lies parallel to the vertebral spines.
- * it extends from the sup. angle above to the inf. angle below.
- * it shows an obtuse angle opposite the root of the spine.

(3) lateral (axillary) border:

- * it is the thickest border because it gives attachments to muscles & acts as a fulcrum for rotation of the scapula.
- * it extends from the lat. angle (glenoid cavity) to the inf. angle.
- * its dorsal aspect shows a flattened area for muscular attachment.



(C) ANGLES OF THE SCAPULA

(1) Sup. angle:

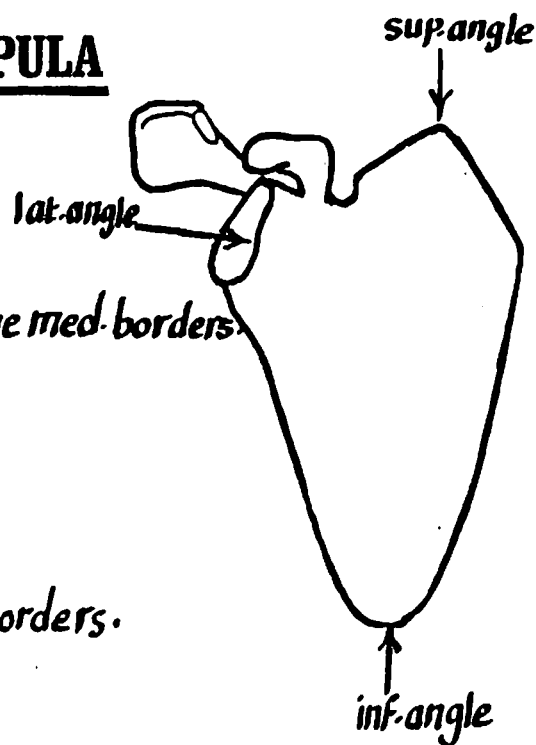
- * it is nearly a right angle.
- * it lies opposite the 2nd rib.
- * it forms the junction between the sup. & the med. borders.

(2) inf. angle:

- * it is an acute angle.
- * it lies opposite the 7th rib.
- * it forms the junction of the lat. & med. borders.

(3) lateral angle:

- * it is enlarged to form the head & neck of scapula.
- * it lies between the sup. & the lat. borders.
- * the head carries a pear-shaped concavity called the glenoid cavity for articulation with the head of humerus.
- * the glenoid cavity is wide below & narrow above. Its margins give attachment to the labrum glenoidale (fibro-cartilagenous lip).



5

This diagram shows the subscapular fossa, a large, triangular depression on the posterior surface of the scapula. The label 'subscapular fossa' is written vertically within the fossa. A line points from the text 'lateral process' to the lateral process of the scapula, which is a small projection at the top of the scapula.

-
- This diagram illustrates the scapula, a triangular bone of the shoulder girdle. The **supraspinous fossa** is the large, shallow depression on the superior surface, bounded by the **coracoclavicular ligament** and the **coracoclavicular ligament**. The **infraspinous fossa** is the large, shallow depression on the inferior surface, bounded by the **coracoclavicular ligament** and the **coracoclavicular ligament**. The **acromion** is the bony process at the top of the scapula, and the **scapula** is the bone itself.

- Coracoid process acromion

Spine

Diagram of the scapula (shoulder blade) showing the following labeled features:

- spinoglenoid notch
- tubercle of Crest of spine

- * the med. border " " " " upper lip of the crest of the spine
& carries an oval facet for articulation with the clavicle.

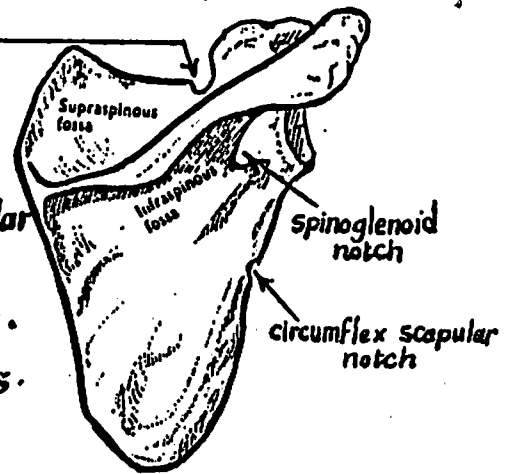
(3) Coracoid process :

- * it projects forwards & slightly laterally from the upper aspect of the head of scapula.
- * it has : (a) tip (b) upper surface (c) lower surface (d) med. border (e) lat. border.

(F) NOTCHES OF THE SCAPULA

(1) Supra-scapular notch :

- * it lies at the lat. end of the sup. border close to the root of the coracoid process.
- * it is transformed into foramen by the suprascapular ligament.
- * through the foramen passes the suprascapular n. & above the lig. passes the suprascapular vessels.



(2) Spino-glenoid notch :

- * lies between the lat. free border of the spine & the glenoid cavity.
- * this notch transmits the suprascapular vessel from the supraspinous fossa to the infraspinous fossa.

(3) circumflex scapular notch :

it is a groove on the dorsal aspect of the lat. border produced by the circumflex scapular artery.

(G) TUBERCLES OF THE SCAPULA

(1) Supra-glenoid tubercle :

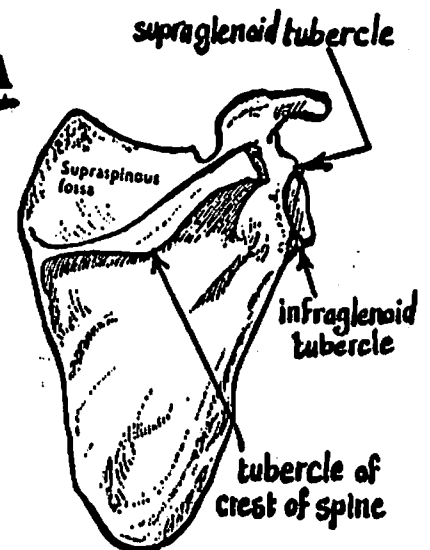
a small rough projection above the glenoid cavity

(2) Infra-glenoid tubercle :

a rough triangular area just below the glenoid cavity

(3) Tubercle of the crest of spine :

a triangular rough projection from the lower lip of the crest of spine.



OSSIFICATION OF THE SCAPULA : see page 137

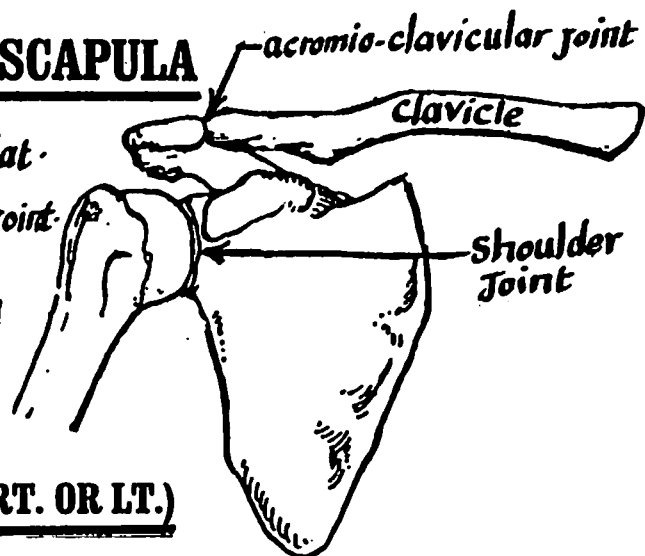
* SUBCUTANEOUS BONY LANDMARKS :

- (1) the acromion & acromial angle : lie immediately above the smooth bulge of the deltoid
- (2) Coracoid process : lies deep, 1" below the junction of the lat. $\frac{1}{4}$ & med. $\frac{3}{4}$ of the clavicle.
- (3) the crest of the spine of the scapula.
- (4) the inferior angle
- (5) the lower $\frac{2}{3}$ of the med. border.

- (1) Transmission of the weight of the upper limb to the clavicle .
- (2) provides a wide surface for muscular attachments .

ARTICULATIONS OF THE SCAPULA

- (1) the acromion process articulates with the lat. end of the clavicle in the acromio-clavicular joint.
- (2) the glenoid cavity articulates with the head of humerus in the shoulder joint.



IDENTIFICATION OF THE SIDE OF SCAPULA (RT. OR LT.)

- (1) the glenoid cavity is directed laterally.
- (2) the post. surface is marked by the spine .
- (3) the upper border is the shortest border

PARTICULAR FEATURES OF THE SCAPULA

I- LIGAMENTS ATTACHED

- (1) Capsule of shoulder joint : attached around the margins of the glenoid cavity.
- (2) the sup., middle & inf. glenohumeral ligaments : attached to the ant. margin of the glenoid cavity.
- (3) Coraco-acromial lig. : extends between the tip of the acromion & the lat. border of the coracoid process.

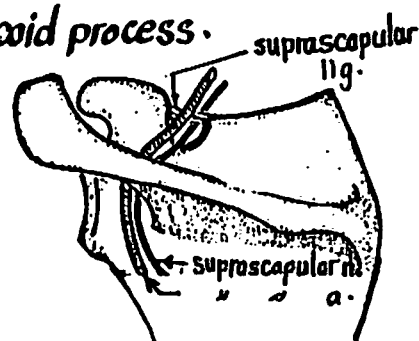
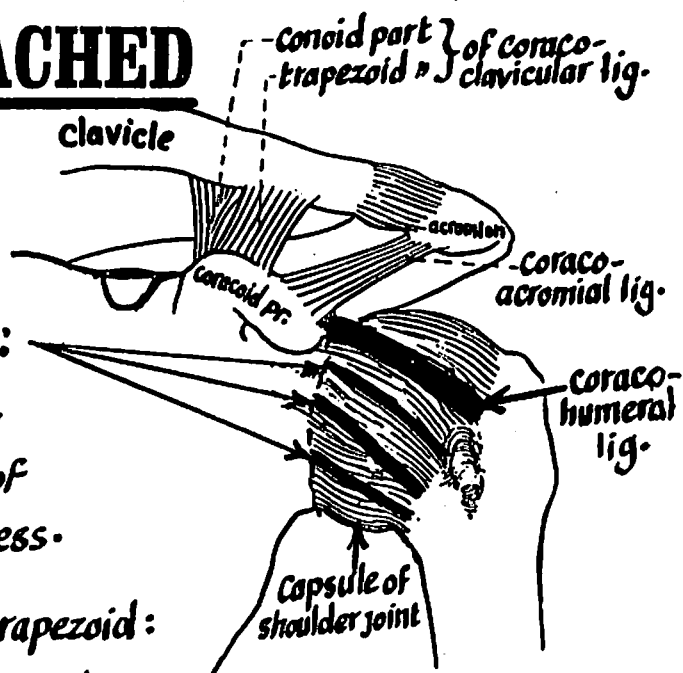
- (4) Coraco-clavicular lig : has 2 parts : conoid & trapezoid :

- (a) the conoid part : attached to a tubercle on the med. border of the coracoid process.
- (b) the trapezoid part : " " the upper surface of the coracoid process .

- (5) Coraco-humeral lig. : attached to the lat. border of the coracoid process .

- (6) Supra-scapular lig. : attached across the supra scapular notch changing it into foramen .

* through the foramen passes the supra scapular nerve .
 * above " " " " " " vessels .



II-- MUSCLES ATTACHED 8

(A) 2 muscles are attached to the costal surface :

- (1) Subscapularis muscle : arises from the med. 3/4 of the subscapular fossa.
- (2) Serratus ant. m. : inserted into the ventral lip of the medial border.

(B) 2 muscles are attached to the dorsal surface :

- (1) Supraspinatus m. : arises from the med. 2/3 of the supraspinous fossa.
- (2) infraspinatus m. : arises from the med. 2/3 of the infraspinous fossa.

(C) 2 muscles are attached to the spine & the acromion :

- (1) Deltoid m. : arises from lower lip of crest of spine + the lat. border of acromion.
- (2) Trapezius m. : inserted into upper lip of crest of spine + the med. border of acromion.

(D) 2 muscles are attached above & below the glenoid cavity :

- (1) long head of biceps m. : arises from the supraglenoid tubercle.
- (2) long head of triceps m. : arises from the infraglenoid tubercle.

(E) 3 muscles are attached to the dorsal aspect of lat. borde

- (1) teres minor m. : arises from the upper 2/3 of dorsal aspect of lat. border.
- (2) teres major m. : arises from the lower 1/3 " " " " " " " " .
- (3) latissimus dorsi m. : arises from the dorsal aspect of lat. border at the inf. angle.

(F) 3 muscles are attached to the dorsal aspect of the medial border :

- (1) Levator scapulae : its insertion extends from the sup. angle to the root of spine.
- (2) Rhomboides minor : is inserted opposite the root of the spine.
- (3) Rhomboides major : is inserted into this border from the root of spine to the inf. angle.

(G) 3 muscles are attached to the coracoid process :

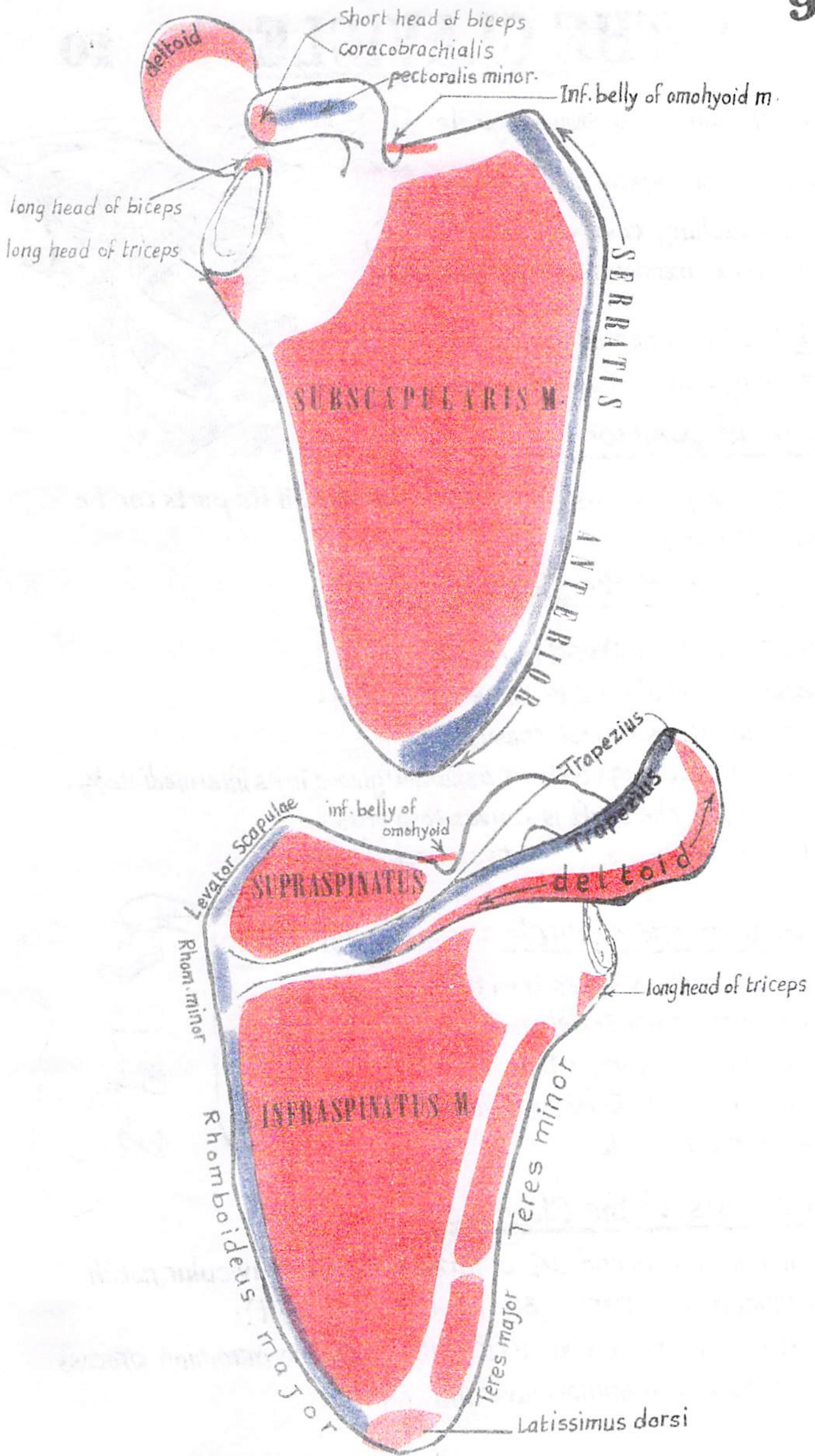
- (1) Pectoralis minor : inserted into med. border & upper surface of the coracoid pr.
- (2) Coracobrachialis m.
- (3) Short head of biceps } have common origin from the tip of the " " .

(H) 1 muscle is attached to the upper border of the scapula :

- inf. belly of omohyoid m. arises from the suprascapular lig. & the adjoining part of the sup. border.

Ventral surface of right scapula. Muscles attached

Dorsal surface of right scapula. Muscles attached



2-THE CLAVICLE

10

It is the ant. bone of the shoulder girdle.

Type : it is a non-typical long bone as :

- (1) it has no medullary cavity.
- (2) it develops by membranous ossification.

Structure : it is formed of spongy bone covered by a layer of compact bone.

Anatomical position :

it lies horizontally at the root of the neck. Almost all its parts can be felt subcutaneously.

Identification of the Side (Rt. or Lt.) :

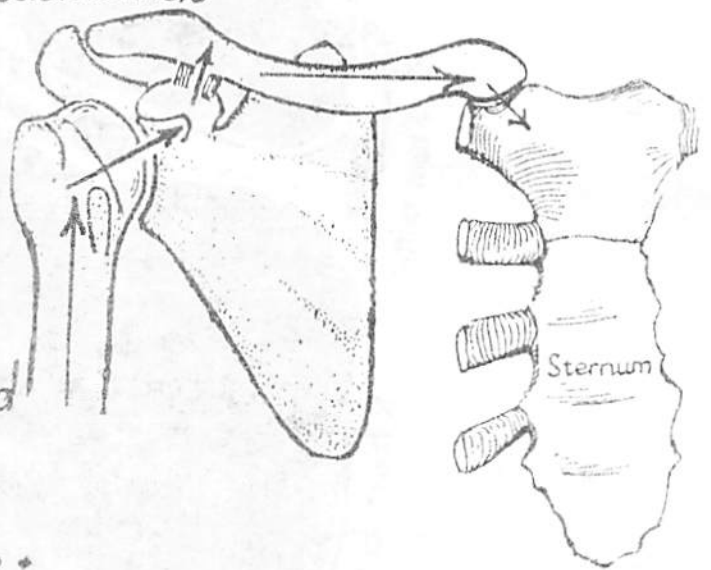
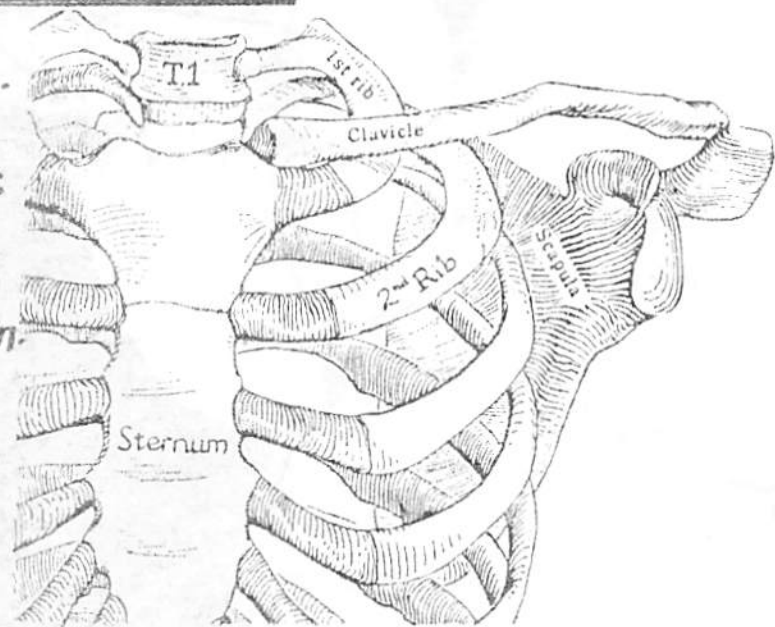
- (1) the lateral (acromial) end is flattened.
- (2) the medial (sternal) end is thick & rounded.
- (3) the upper surface is almost smooth.
- (4) the lower surface is rough & shows a shallow groove in its intermediate $\frac{1}{3}$.
- (5) the med. $\frac{2}{3}$ of the shaft is convex forwards.
- (6) the lat. $\frac{1}{3}$ " " " " Convex backwards.

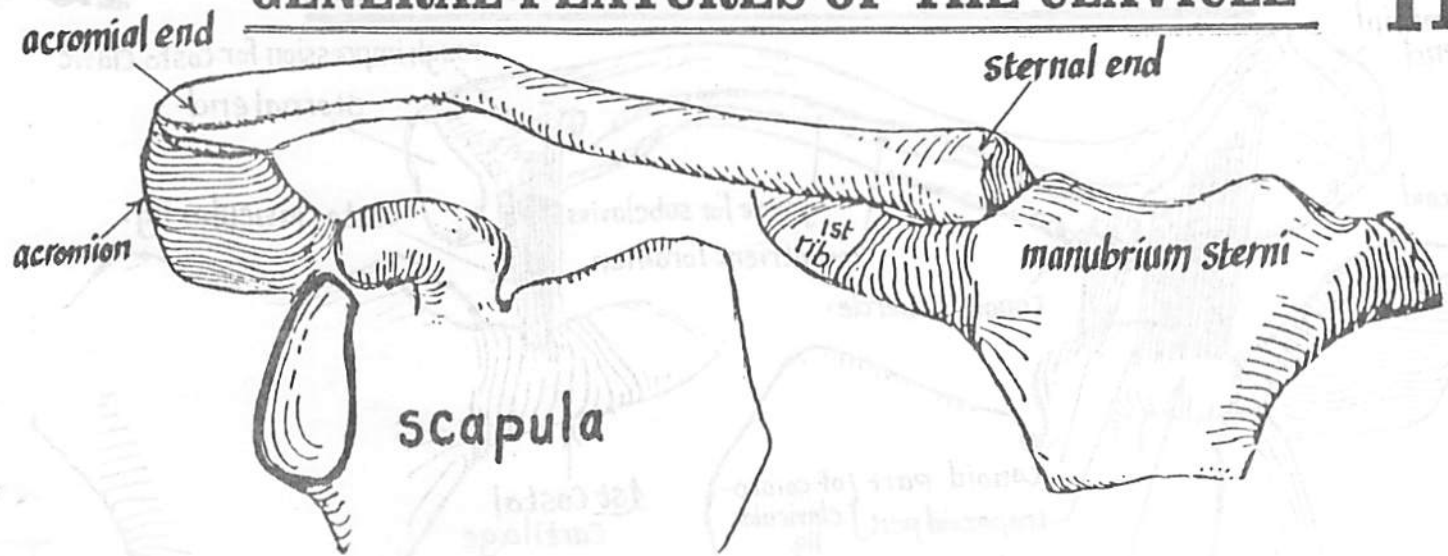
Functions of the clavicle :

- 1) it transmits weight & forces from the upper limb to the axial skeleton.
- 2) it braces back the shoulder thus allowing the upper limb to be suspended free away from the trunk.

Articulations of the Clavicle :

- (1) its medial or sternal end articulates with the clavicular notch of the manubrium sterni (sternoclavicular joint).
- (2) its lateral or acromial end articulates with the acromion process of the scapula (acromio-clavicular joint).





* the clavicle has a shaft & 2 ends (med. & lat.)

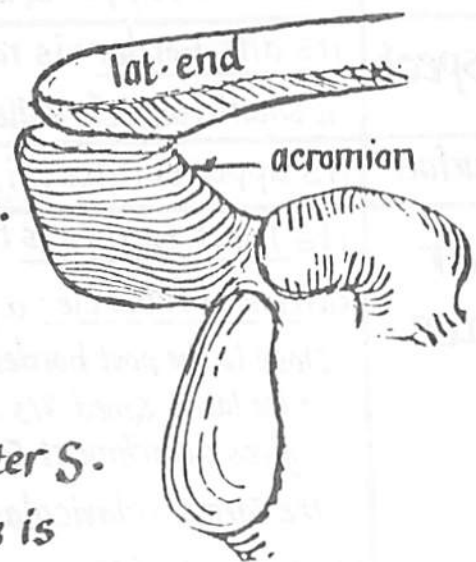
(I) the medial (sternal) end:

- * is large, rounded or quadrangular in shape.
- * it presents a smooth facet for articulation with the clavicular facet of the manubrium sterni.
- * the lower part of the facet extends slightly on the inf. surface of the med. end for articulation with the 1st Costal cartilage (Fibrous joint).
- * the rough area above the articular facet gives attachment to the interclavicular ligament.



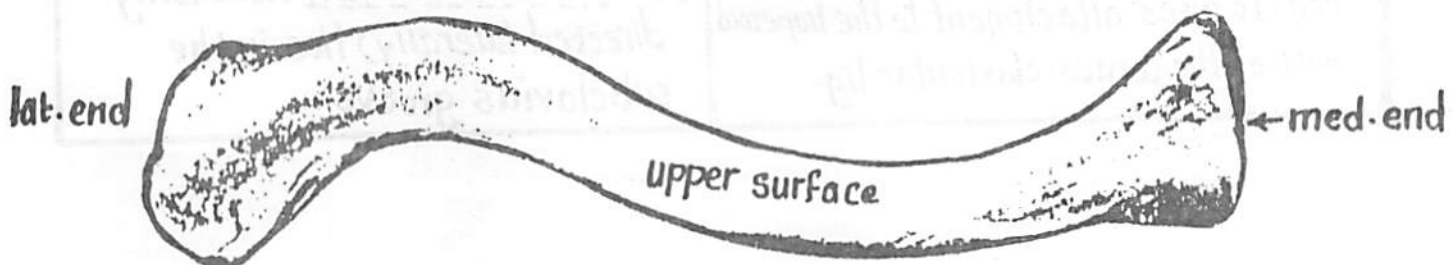
II- the lateral (acromial) end:

- * is flattened & carries an oval facet for articulation with the acromion process of scapula.
- at the acromioclavicular joint

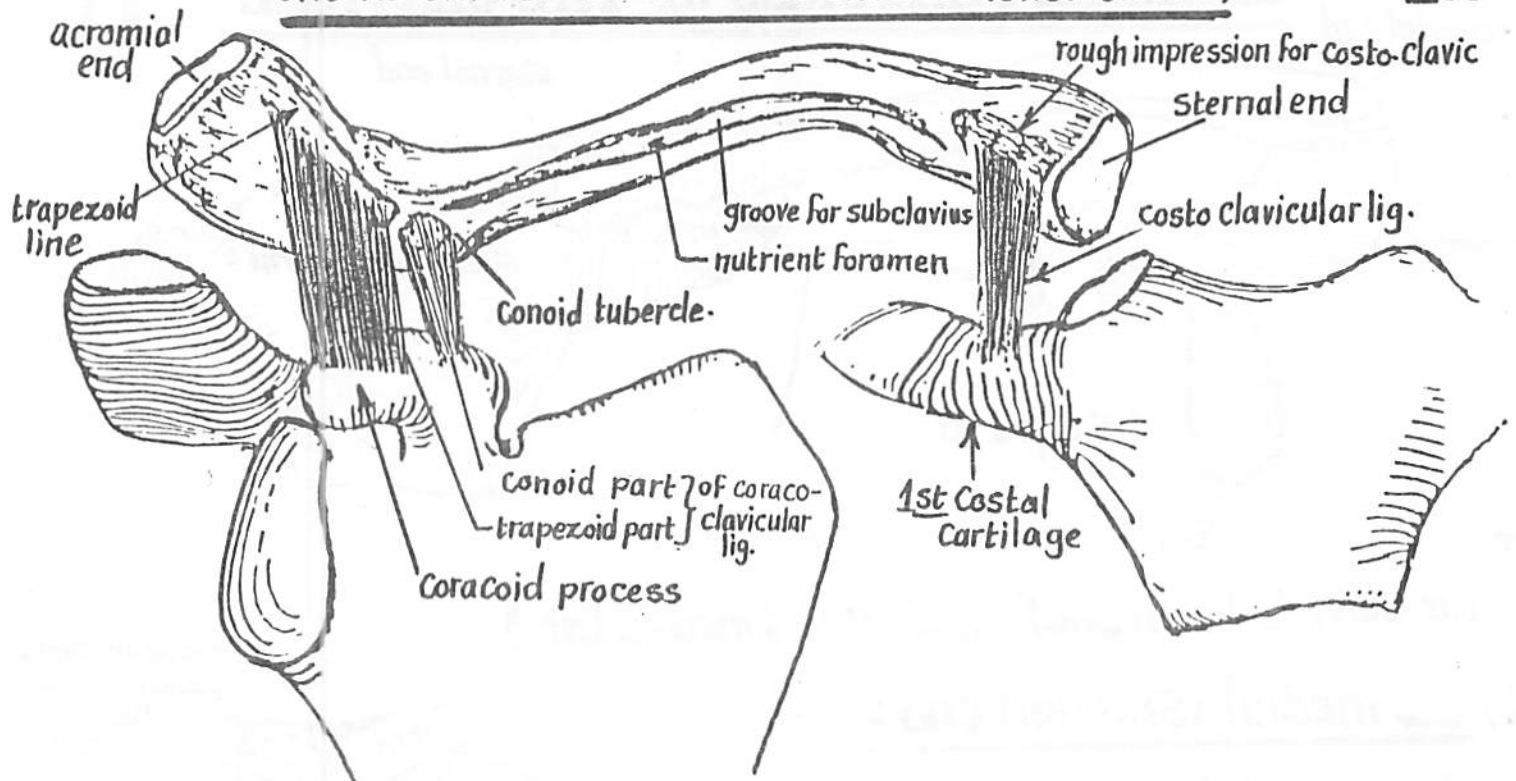


III the Shaft of the clavicle:

- * presents a double curvature resembling the letter S.
- * its med. 2/3 is convex forwards while its lat. 1/3 is convex backwards

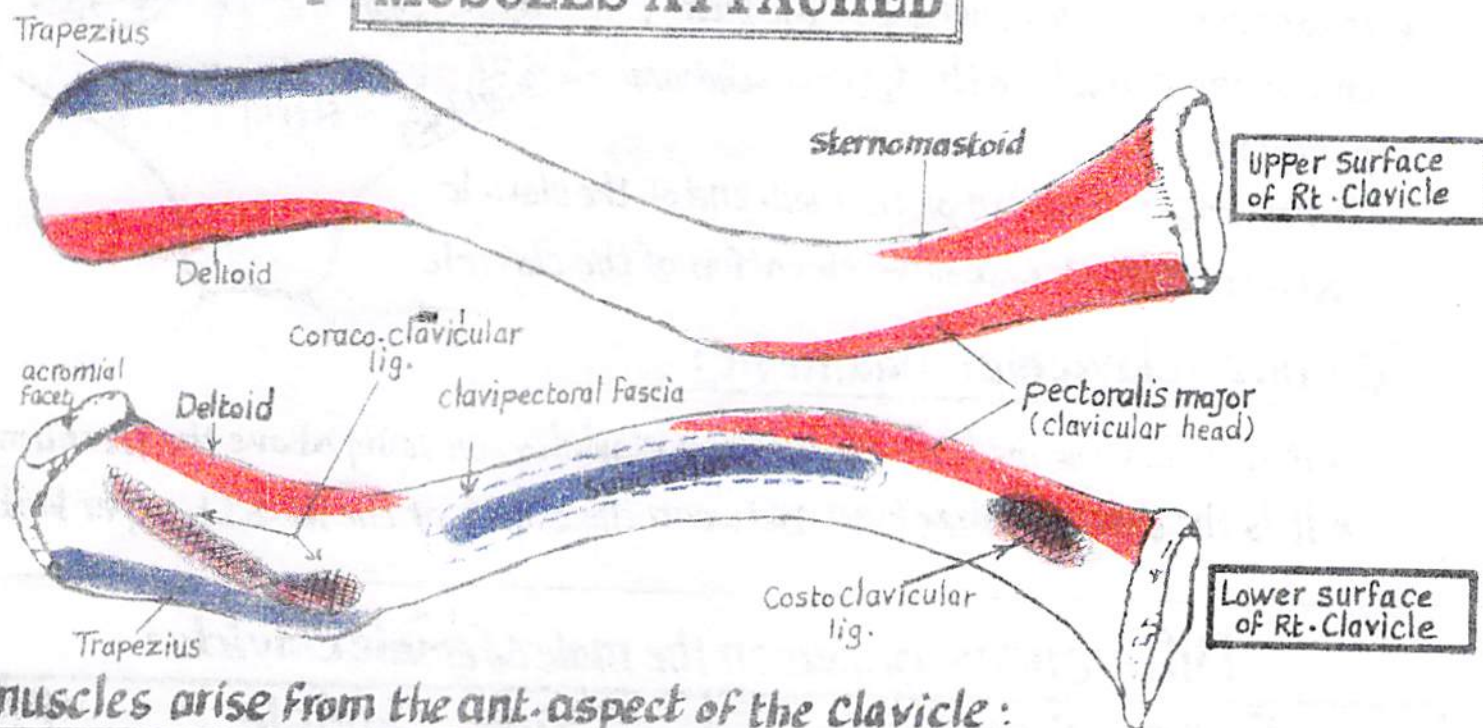


the Rt. clavicle (reflected to show its lower surface)



	Lateral $\frac{1}{3}$ of the shaft	Medial $\frac{2}{3}$ of the shaft
direction	it is convex backwards to meet the acromial process of the scapula.	it is convex forwards to widen the space behind it for the passage of the vessels & nerves passing from the root of the neck to the axilla
Shape	it is flattened, having ant- & post- borders, upper & lower surfaces:	it is cylindrical in form having ant- post-, upper & lower surfaces:
ant aspect	its <u>ant- border</u> : is rough & may present a small tubercle called the <u>deltoid tubercle</u>	* its <u>ant- surface</u> is rough medially (for origin of pectoralis major m.)
upper surface	its upper surface: is smooth	* its upper surface is smooth.
lower Surface	its <u>lower surface</u> is rough & shows: (a) <u>Conoid tubercle</u> : a prominent tubercle close to the post border (at the junction of the lat. $\frac{1}{3}$ & med. $\frac{2}{3}$ of the shaft). it gives attachment to the conoid part of the coraco-clavicular lig. (b) <u>trapezoid line</u> : a rough line extending from the conoid tubercle to the acromial end. It gives attachment to the trapezoid part of the coraco-clavicular lig.	* its <u>lower surface</u> is rough & shows: (a) a rough <u>depressed impression</u> near the med- end for the attachment of the costo-clavicular ligament. (b) a <u>groove</u> for insertion of the subclavius m. in the intermediate $\frac{1}{3}$ of the lower surface. (c) a <u>nutrient foramen</u> (commonly directed laterally) lies in the subclavius groove.

I- MUSCLES ATTACHED



A) 2 muscles arise from the ant. aspect of the clavicle :

- (1) Pectoralis major m. : From the med. $\frac{1}{2}$ of the ant. aspect
- (2) Deltoid m. : From the lat. $\frac{1}{3}$ of the ant. aspect.

B) 2 muscles are attached to the post. aspect of the clavicle :

- (1) Sternomastoid m. (origin) : From the med. $\frac{1}{3}$ of post. & upper surfaces.
- (2) Trapezius m. (insertion) : into the lat. $\frac{1}{3}$ of post. aspect

C) one muscle (the subclavius) is inserted into the middle $\frac{1}{3}$ of the inf. surface.

II- LIGAMENTS ATTACHED

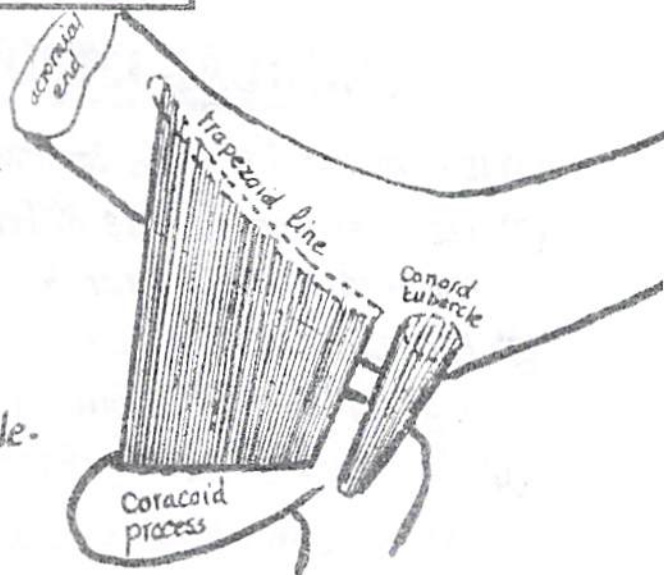
(1) Coraco-clavicular ligament :

* it is a very strong lig. connecting the lower surface of the lat. $\frac{1}{3}$ of the clavicle to the upper surface of the coracoid process of scapula.

* it has 2 parts :

- (a) Conoid part : attached to the conoid tubercle.
- (b) trapezoid part : " " " trapezoid line

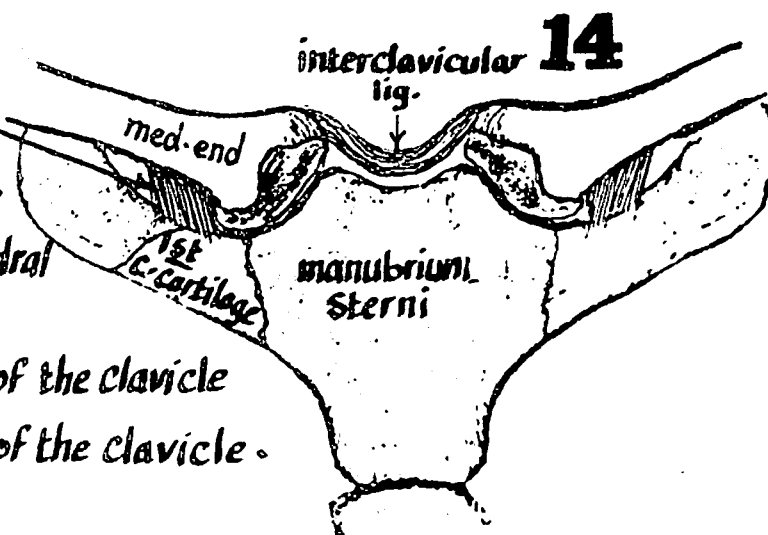
* importance : it transmits most of the weight of the upper limb to the clavicle.



(2) Costo-Clavicular ligament :

* it connects the inf. surface of the med. end of the clavicle to the 1st Costo-Chondral junction.

* importance: fixation of the med. end of the clavicle & prevention of excessive elevation of the clavicle.



(3) Inter-clavicular ligament :

* it connects the medial ends of the 2 clavicles, crossing above the sternum.

* it is the **only connection** between the bones of the Rt. & Lt. upper limbs.

Differences between the male & female clavicle :

Female Clavicle	Male Clavicle
shorter, thinner, smoother & less curved	longer, thicker, more curved
has less prominent muscular impressions	has more prominent muscular impressions.
in the living, the acromial end is slightly below the level of the sternal end	the acromial end lies on the same level as the sternal end.

OSSIFICATION OF THE CLAVICLE : see page 137

SUBCUTANEOUS BONY LANDMARKS : the whole shaft & the 2 ends of the clavicle are subcutaneous.

CLINICAL IMPORTANCE OF THE CLAVICLE

(1) it is one of the most commonly fractured bones in the body.

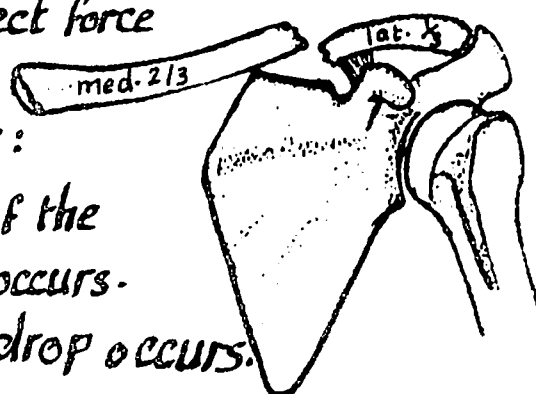
(2) the most common site of fracture is the junction between the med. 2/3 & the lat. 1/3 of the shaft (a weak point).

(3) the cause of the fracture is commonly an indirect force e.g. falling on the outstretched hand.

(4) the effect of the fracture depends on its site :

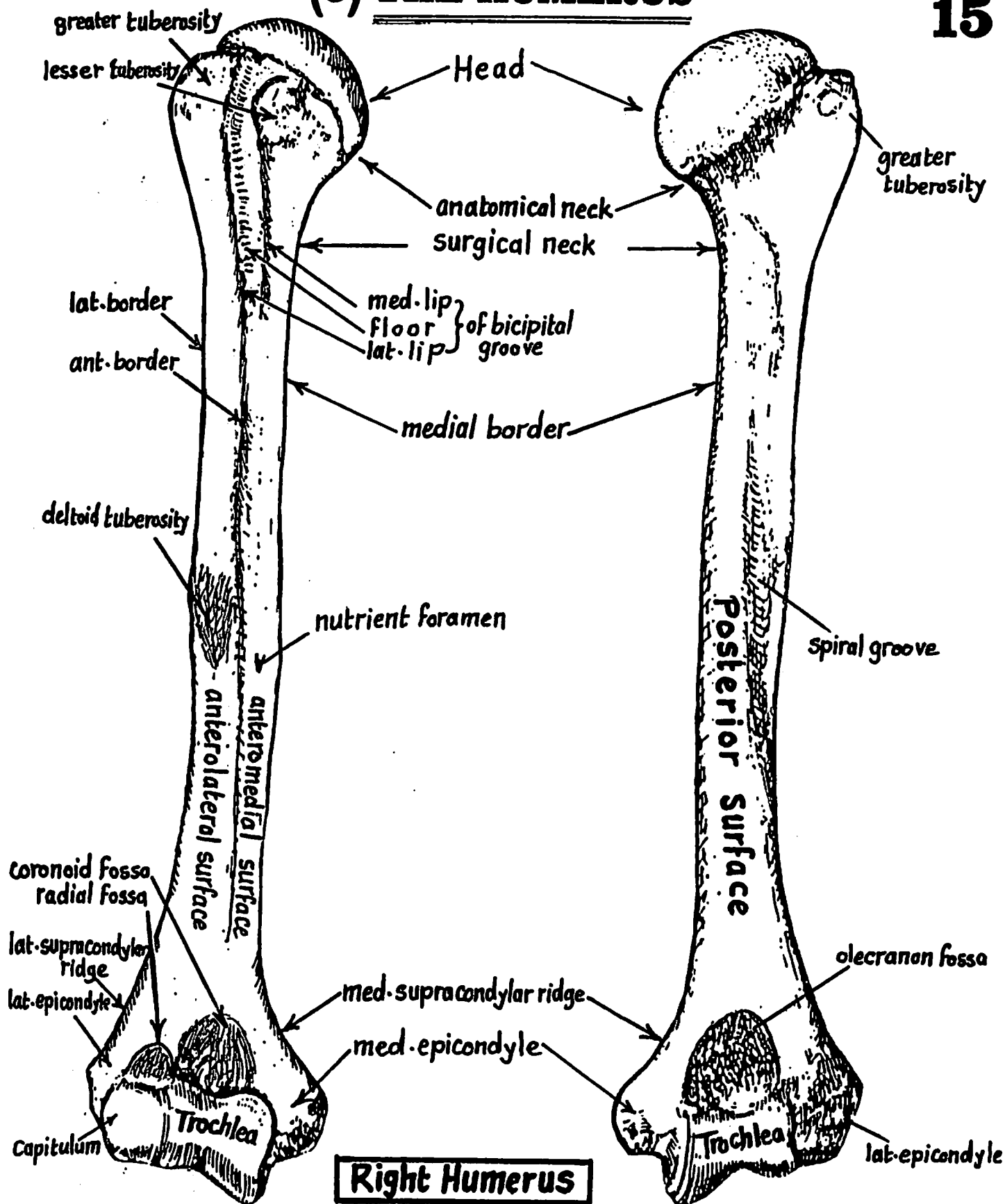
(a) if the fracture is med. to the attachment of the Coraco Clavicular lig. drop of the shoulder occurs.

(b) if the fracture is lat. to the ligament, no drop occurs.



(3) THE HUMERUS

15



I- Type: it is a typical long bone. It develops by cartilagenous ossification.

II- Position: it is the bone of the arm.

III- identification of the Side (Rt. or Lt.):

- (1) the upper end is identified by the hemispherical head.
- (2) the lower " " " " " trochlea & capitulum.
- (3) the med. side is identified by the head (directed medially).
- (4) the post. surface is " " " deep olecranon fossa in the lower end.

GENERAL FEATURES OF THE HUMERUS 16

the humerus is composed of a shaft & 2 expanded ends: upper & lower

(1) THE UPPER END:
→ head.
→ 2 tuberosities (greater & lesser).
→ 2 necks (anatomical & surgical).

(A) the head of the humerus:

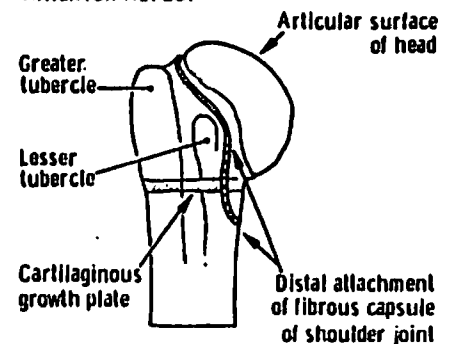
- * forms less than $\frac{1}{2}$ sphere & covered with articular cartilage (in the living).
- * it is directed upwards, medially & backwards.
- * it articulates with the glenoid cavity of the scapula at the shoulder joint.

(B) the Anatomical neck:

- * it is the constriction close to the margins of the head separating it from the 2 tuberosities.
- * it gives attachment to the capsule of shoulder joint (except medially where the capsule descends for 1 cm. to reach the surgical neck).

RIGHT HUMERUS: UPPER END

ANTERIOR ASPECT



(C) the Surgical neck:

- * it is the junction between the upper end & the shaft
- * it lies about one finger breadth below the head & the 2 tuberosities.
- * it is related medially to the circumflex n. & post. circumflex humeral vessels.

(D) Lesser tuberosity:

- * it projects forwards medial to the intertubercular sulcus.
- * it shows one facet on its upper part (for the subscapularis m.).
- * its lat. edge is continuous below with the med. lip of the bicipital groove.

(E) Greater tuberosity:

- * lies on the lat. part of the upper end of the humerus.
- * its ant. margin is continuous below with the lat. lip of the bicipital groove.
- * it shows 3 facets for muscular attachments on its upper & post-aspects

(F) the intertubercular sulcus (bicipital groove):

- * it lies between the 2 tuberosities & extends to the upper $\frac{1}{3}$ of the shaft.
- * it has a floor & 2 lips (med. & lat.) for muscular attachments.
- * it lodges the tendon of the long head of biceps m.
- * its upper part is bridged-over by the transverse humeral lig.

(2) THE LOWER END

17

(A) the articular parts:

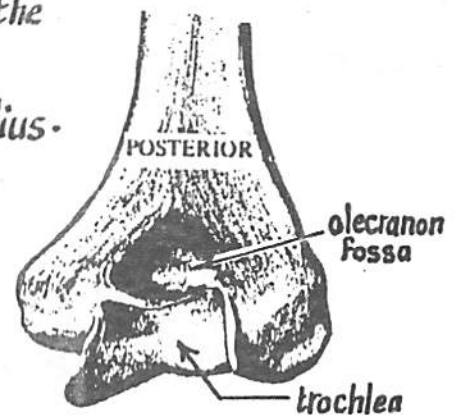
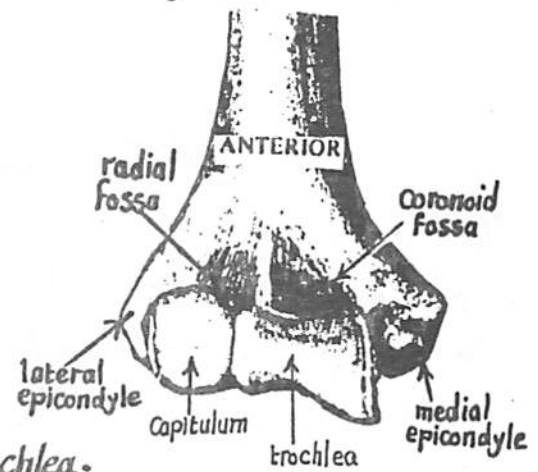
include the trochlea & the capitulum representing modified condyles of lower end.

(1) the trochlea:

- * it is a pully-like process covering the ant., inf & post. parts of the medial articular part of lower end.
- * it articulates with the trochlear notch of ulna.
- * its med. lip projects more down than the lat. lip.

(2) the Capitulum:

- * it is a small ball-like process lying lat. to the trochlea.
- * it covers the ant. & inf. surfaces only of the lat. part of the of the articular surface of the lower end.
- * it articulates with the upper surface of the head of radius.



(B) The epicondyles:

(1) Med. epicondyle:

- * it projects from the med. side of the lower end
- * it is more prominent than the lat. epicondyle & is subcutaneous.
- * its ant. surface shows a rough impression for muscular attachment.
- * its post surface may show a shallow groove (for ulnar nerve).

(2) Lat. epicondyle:

- * it projects from the lat. side of the lower end (less prominent than med. epicondyle).
- * its ant. & lat. surfaces show rough impressions for muscular attachments.

(C) The 3 Fossae:

(1) Olecranon fossa:

- * it is a deep depression on the post. surface of the lower end above the trochlea.
- * it lodges the tip of the olecranon process of ulna when the elbow is extended.

(2) Radial fossa:

- * it is a very shallow depression on the ant. surface of the lower end above capitulum.
- * it receives the margin of the head of radius in full flexion of elbow.

(3) Coronoid fossa:

- * a shallow depression above the trochlea on the ant. surface of the lower end.
- * it receives the tip of the coronoid process of ulna in full flexion of elbow.

(3) THE SHAFT OF THE HUMERUS

18

- * it has 3 borders & 3 surfaces.
- * its upper $\frac{1}{2}$ is rounded in cross-section
- * its lower $\frac{1}{2}$ is triangular in " "

Borders of the humerus

(1) Anterior border:

- * its upper part forms the lat. lip of the bicipital groove
- * its middle part forms the ant. boundary of the deltoid tuberosity.
- * its lower part is smooth & rounded.

(2) Medial border:

- * it extends from the lesser tuberosity above to the med. epicondyle below.
- * its upper part is ill defined while its lower end (above the med. epicondyle) is prominent & called med. supracondylar ridge.

(3) Lateral border:

- * it extends from the back of the greater tuberosity above to the lat. epicondyle below.
- * its lower part is prominent & called lat. supracondylar ridge

Surfaces of the humerus

(1) Anteromedial surface:

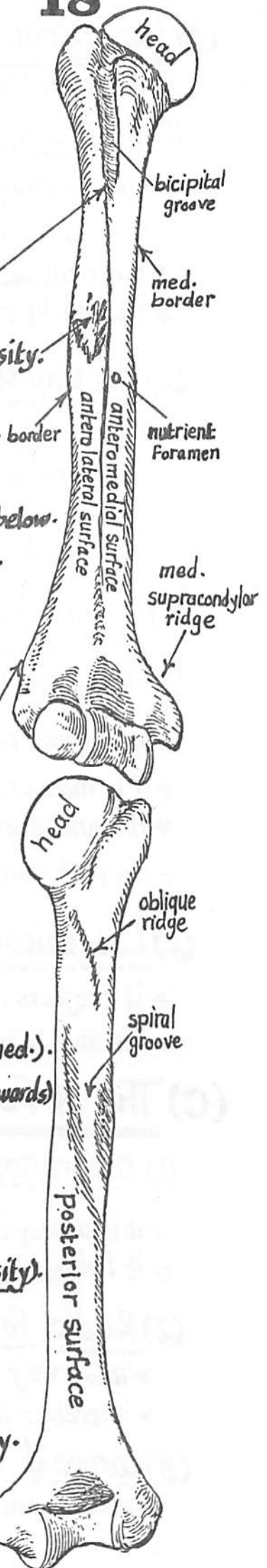
- * lies between the ant. & med. borders
- * its upper $\frac{1}{3}$ presents the bicipital groove (having floor & 2 lips: lat. & med.).
- * a little below its middle it shows a nutrient foramen (directed downwards)

(2) Anterolateral surface:

- * lies between the ant. & the lateral borders.
- * its middle part shows a v-shaped rough area (deltoid tuberosity).

(3) Posterior surface:

- * lies between the med. & lateral borders.
- * its upper $\frac{1}{3}$ show an oblique ridge passing downwards & laterally.
- * its middle $\frac{1}{3}$ is crossed by the spiral groove (for radial n.) passing downwards & laterally.



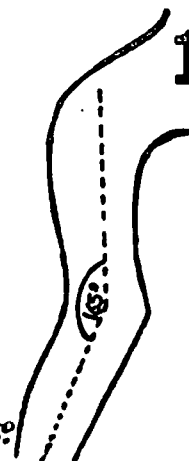
ANGLES OF THE HUMERUS

19

(1) the carrying angle : it is the angle between the long axis of the arm & the long axis of the forearm & it is about 165°

* Cause of this angle : the med. lip of the trochlea projects downwards causing lateral deviation of the ulna.

(2) Angle of torsion : it is the angle between the long axis of the upper end & the long axis of the lower end of humerus. It is also 165°



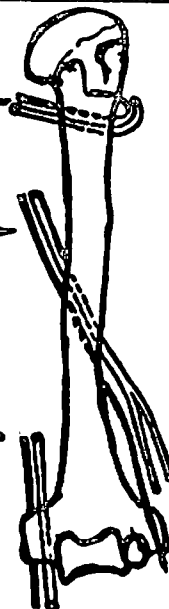
NERVES RELATED TO THE HUMERUS

(1) Circumflex (axillary) n ; post. circumflex humeral vessels ————— curve around the surgical neck.

(2) radial nerve (accompanied by the profunda brachii vessels) ————— pass in the spiral groove of the humerus.

(3) ulnar nerve (accompanied by sup. ulnar collateral vessels) ————— pass behind the med. epicondyle.

N.B : the above mentioned nerves are liable to be injured in fractures of the humerus because they lie in contact with the bone.



PARTICULAR FEATURES OF THE HUMERUS

I—LIGAMENTS ATTACHED

(1) Capsule of shoulder joint : attached to the anatomical neck except medially where it descends for 1cm. to reach the surgical neck.

(2) Coracohumeral lig. : attached to the greater tuberosity & the upper most part of the anatomical neck.

(3) gleno-humeral ligaments : sup., middle & inferior :

- the sup. is attached just above the lesser tuberosity.

- " middle " " " below " " "

- " inferior " " " to the lower part of the anatomical neck.

(4) transverse humeral lig. : attached between the 2 tuberosities across the upper part of the intertubercular sulcus.

(5) the lat.-intermuscular septum : attached to the lat. supracondylar ridge & lat. border of humerus.

(6) the med. intermuscular septum : attached to the med. supracondylar ridge & med. border of humerus.

(7) Capsule of the elbow joint : attached around the articular surfaces of the lower end above the 3 fossae.

II- **MUSCLES ATTACHED**

20

(A) 3 muscles are inserted into the greater tuberosity: S-I-T

- (1) Supra-spinatus m. : inserted into the upper most facet of greater tuberosity.
- (2) Infra-spinatus m. : " " " middle facet of the greater tuberosity.
- (3) Teres minor m. : " " " lower facet " " " "

(B) 3 muscles are inserted into the bicipital groove: T-L-P

- (1) Teres major m. : inserted into the Med. lip of the bicipital groove.
- (2) Latissimus dorsi m. : " " " floor " " " "
- (3) Pectoralis major m. : " " " lat. lip " " " "

(C) Subscapularis m. is inserted into the Lesser tuberosity.

(D) the B-C-D muscles

- (1) Brachialis m. : arises from the lower $\frac{1}{2}$ of ant. aspect of the shaft.
- (2) Coracobrachialis : inserted into middle of the medial border of humerus.
- (3) Deltoid m. : inserted into the deltoid tuberosity.

(E) 3 muscles arise from the supracondylar ridges :

- (1) Brachio-radialis m. : arises from the upper $\frac{2}{3}$ of the lat-supracondylar ridge.
- (2) Ext. Carpi radialis longus arises " " lower $\frac{1}{3}$ " " " " " "
- (3) Pronator teres (humeral head) arises from the lower part of med-supracondylar ridge.

(F) 3 muscles arise from the back of the humerus :

- (1) lat. head of triceps : arises from oblique ridge in the upper $\frac{1}{3}$ of post. surface.
- (2) med. " " " : arises from the whole post. surface below the spiral groove.
- (3) anconeus : arises from the back of the lat-epicondyle.

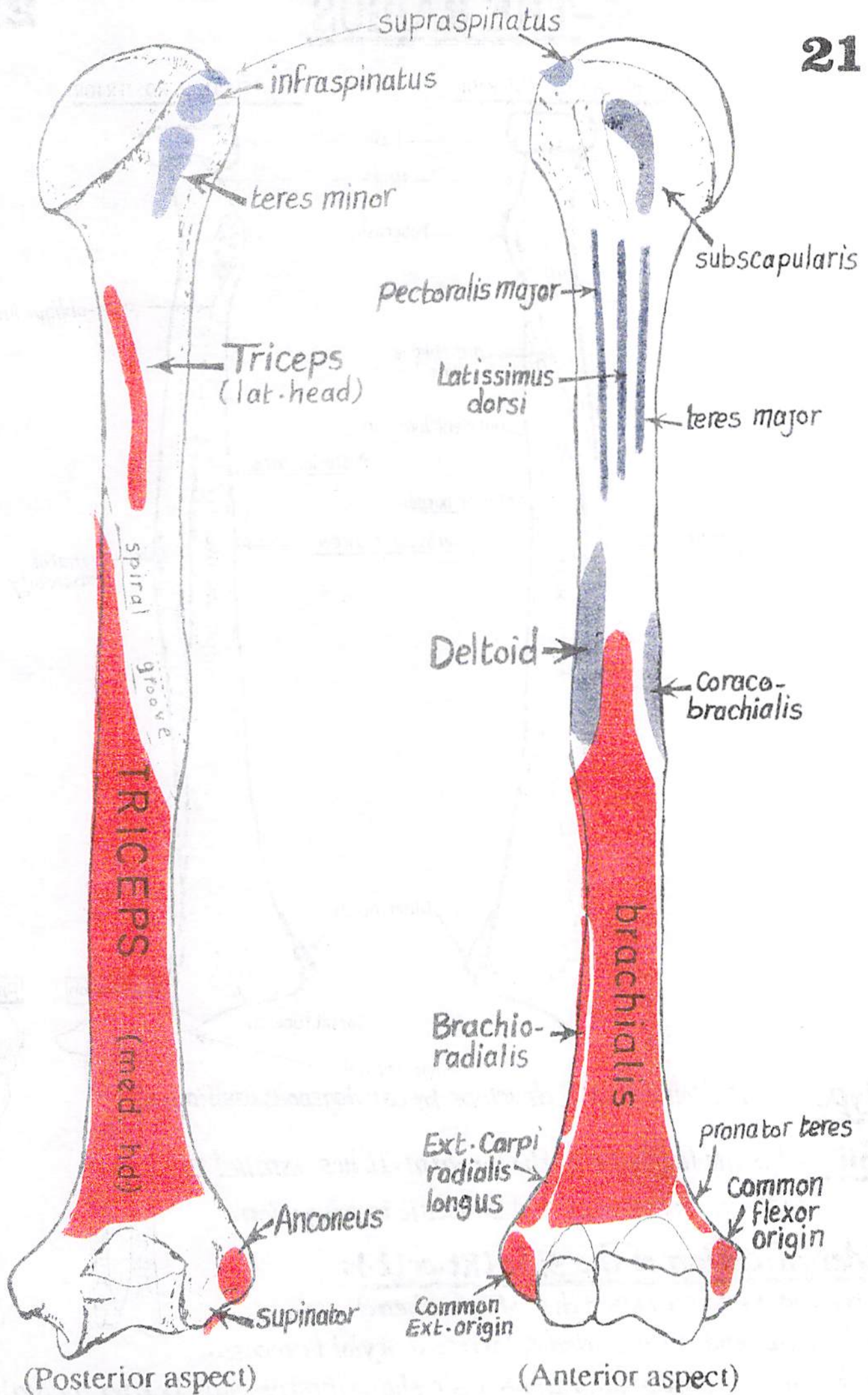
(G) muscles arising from the front of the epicondyles :

- (1) Common Flexor origin (C.F.O) : from the front of the med. epicondyle.
- (2) Common extensor origin (C.E.O) " " " " lat. epicondyle.

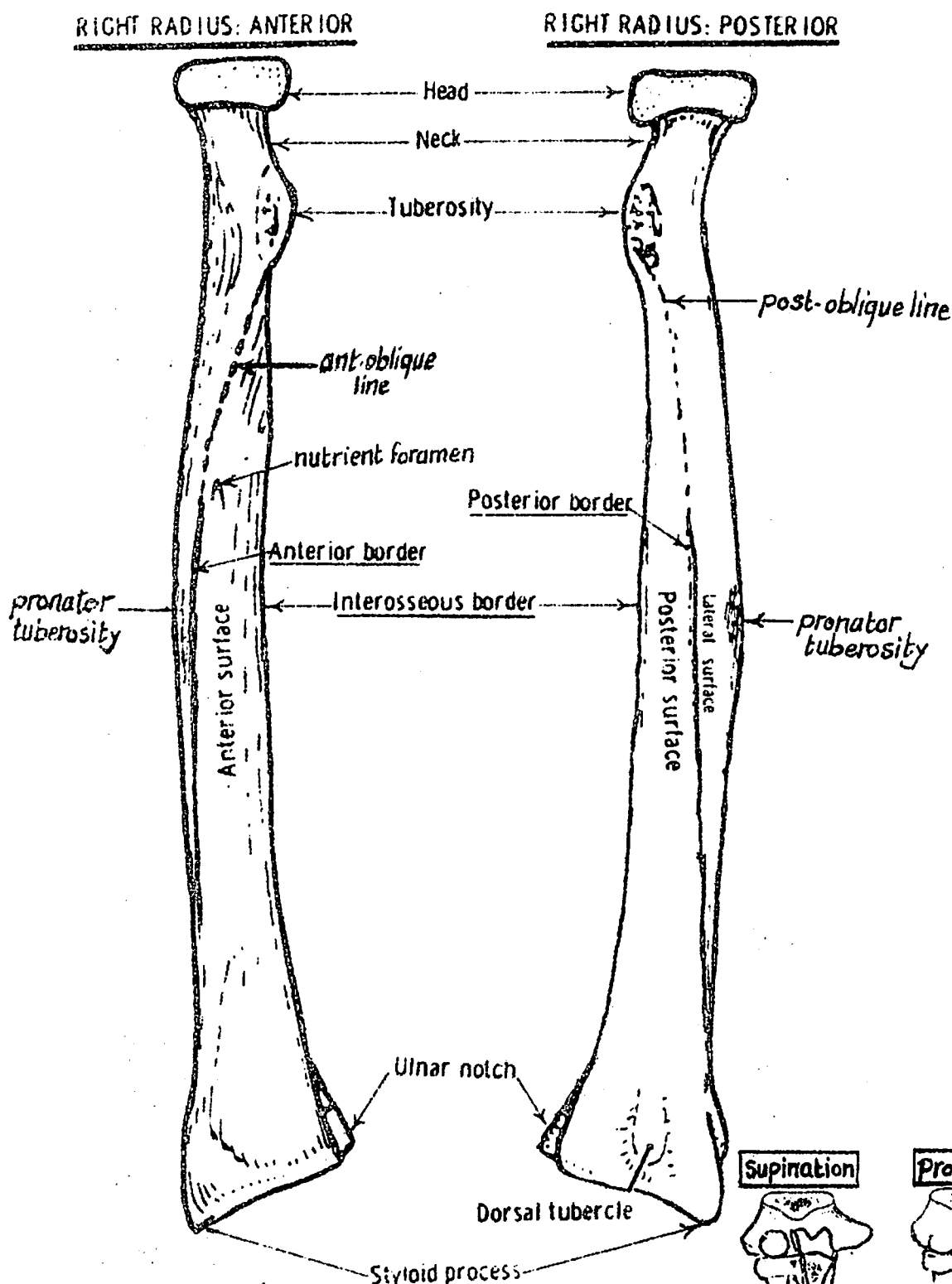
* **OSSIFICATION OF THE HUMERUS** : see page 137

* **SUBCUTANEOUS BONY LANDMARKS :**

- (1) the lateral epicondyle & lateral supracondylar ridge.
- (2) the medial " " medial " " " "



Muscles attached to the right humerus



***Type:** typical long bone. It develops by cartilagenous ossification

***Site:** it is the lat. bone of the forearm. It lies parallel to the ulna in supination but crosses it in pronation.

***Identification of the Side (Rt. or Lt.):**

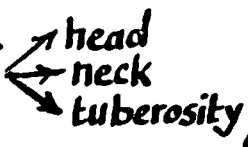
- (1) the upper end carries a disc shaped head.
- (2) the lower end is expanded & carries a styloid process.
- (3) the shaft is convex laterally & has a sharp interosseous border medially
- (4) the ant. surface of the lower end is smooth & Concave

***ossification of the radius:** see page 137.

GENERAL FEATURES

23

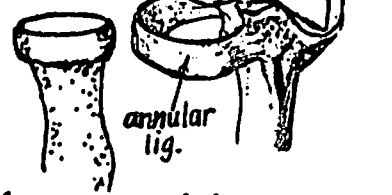
* The radius is formed of a shaft & 2 ends : upper & lower.

(A) THE UPPER END formed of


(1) the head : (disc-shaped) :

* its Concave upper surface articulates with the Capitulum of humerus.

* its Circumference articulates partially with radial notch of ulna & partially with the annular lig. of the sup. radio-ulnar joint.



(2) the neck :

* it is the Constricted part just below the head.

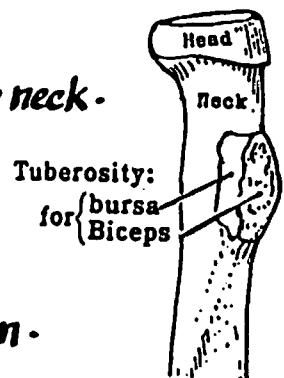
* the lower part of the annular lig. is loosely attached to the neck.

(3) the radial tuberosity :

* it lies below the medial part of the neck.

* its post. rough part receives the insertion of the biceps tendon.

* its ant. smooth part is related to bursa separating it from the biceps tendon.



(B) THE LOWER END

* it is the widest part of the radius. It has 5 surfaces & Styloid process

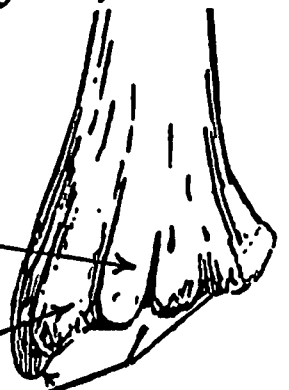
(a) the ant. surface : is smooth & slightly concave.

(b) the post. surface : is rough & Convex. It shows :

(1) a prominent ridge called dorsal tubercle of Lister (it can be felt, in the living, in line with the cleft between the index & middle fingers).

(2) lat. to the dorsal tubercle there is a wide groove.

(3) med. " " " " " are 2 grooves.



(c) the Lateral surface :

* projects downwards beyond the rest of the bone forming the Styloid process which can be felt subcutaneously in the anatomical snuff-box.

* the Styloid process of radius projects 1 cm. below the styloid process of ulna.

* it gives attachment to the lat. lig. of the wrist joint.

(D) the inferior surface:

* it is smooth, concave & is divided by a faint ridge into:

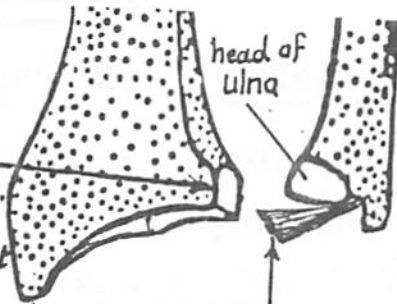
- (1) lat. triangular area for articulation with scaphoid
- (2) med. quadrangular area for articulation with lunate



(E) the medial surface:

* it is concave, forming the ulnar notch of radius which articulates with the head of ulna (inf. radio-ulnar joint).

* the ridge at the lower margin of the notch gives attachment to the base of the triangular articular disc of the inf. radio-ulnar joint.



THE SHAFT OF THE RADIUS

* it has 3 borders & 3 surfaces:

(1) the interosseous border:

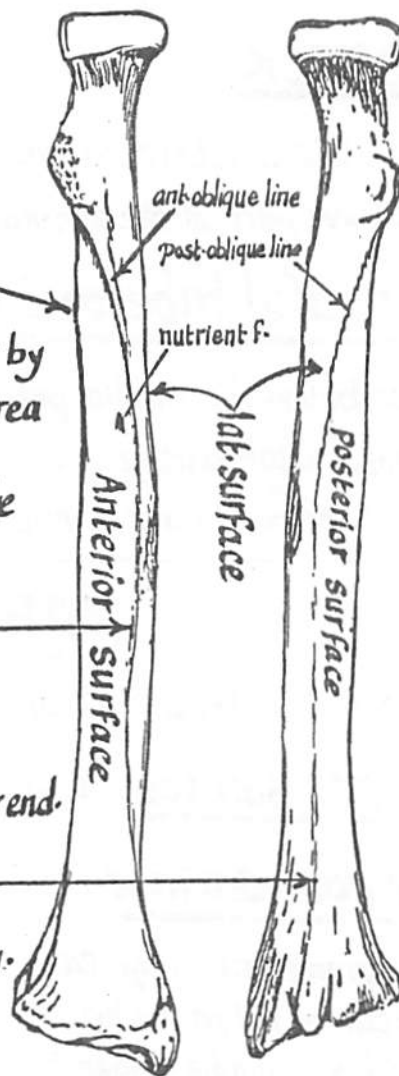
- * it is the sharpest border & is directed medially
- * it begins below the radial tuberosity & ends distally by dividing into 2 lines enclosing a narrow triangular area above the ulnar notch.
- * the upper 2/3 of this border gives attachment to the interosseous membrane.

(2) the anterior border:

- * begins anterolateral to the radial tuberosity.
- * its upper part is called the ant. oblique line.
- * its lower part forms the sharp lat. margin of the lower end.

(3) the posterior border:

- * starts above postero-inferior to the radial tuberosity.
- * its upper part is oblique (post-oblique line).
- * it ends below at the dorsal tubercle of Lister.



(4) Anterior surface: (between the ant. & interosseous borders):

- * its upper 1/3 presents a nutrient foramen (directed towards the elbow).

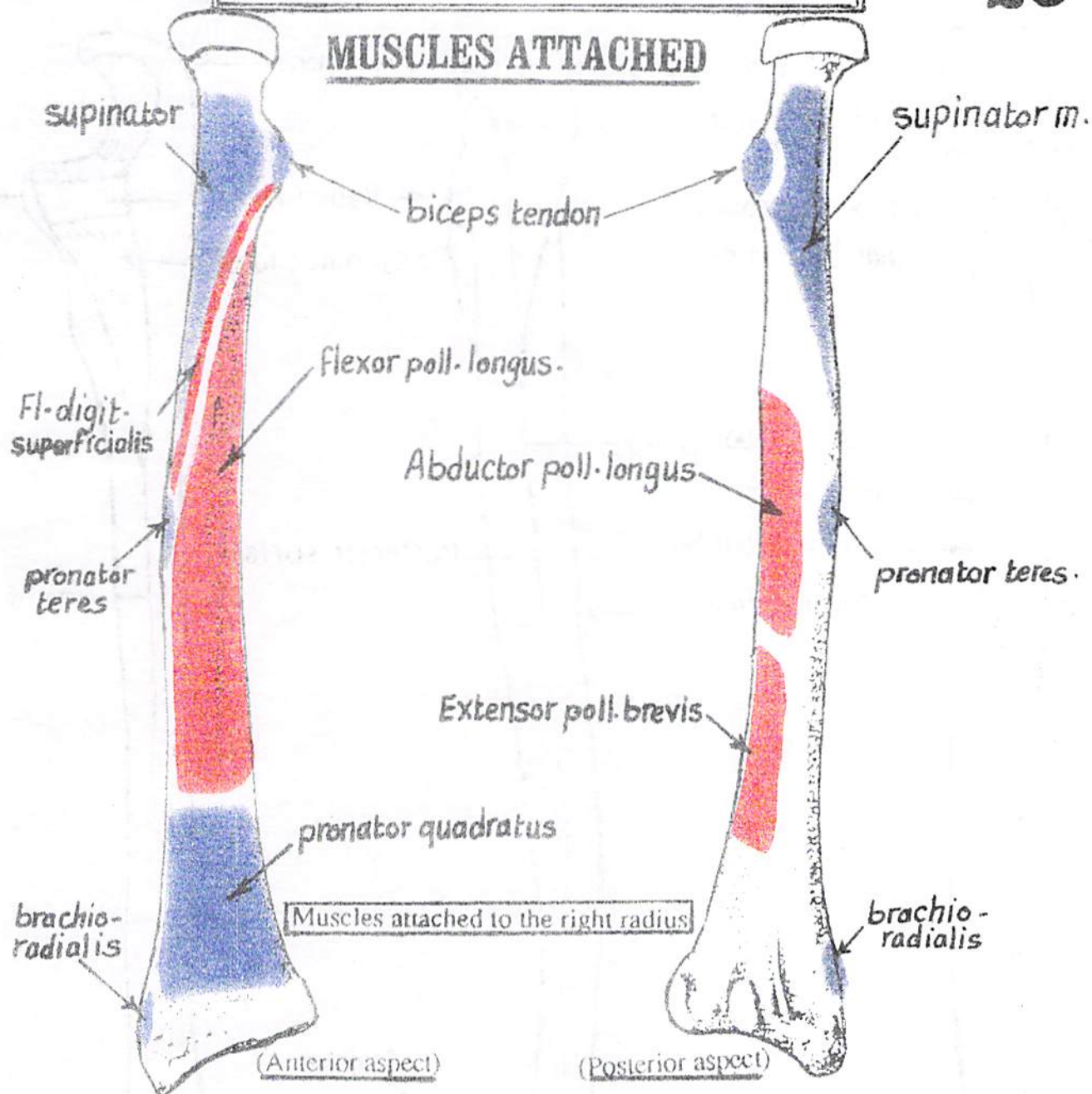
(5) Posterior Surface: is rather flat & lies between the post. & interosseous borders.

(6) Lateral surface: is convex & lies between the ant. & post. borders.

- * it presents a rough impression (pronator tuberosity) at its middle.

* Subcutaneous bony landmarks of radius:

- (1) back of the head: felt on the back of elbow just below the lat. epicondyle.
- (2) Post. surface of the lower end
- (3) the styloid process (felt in the anatomical snuff-box).



(A) Biceps tendon: inserted in the post. part of the radial tuberosity.

(B) 3 muscles are attached to the ant. aspect of radius

- (1) Flexor digitorum superficialis (radial head): arises from ant. oblique line.
- (2) flexor pollicis longus: arises from the upper $\frac{2}{3}$ of ant. surface (below ant. obl. line).
- (3) pronator quadratus: inserted into the lower $\frac{1}{4}$ of ant. surface of radius.

(C) 3 muscles are inserted into the lateral aspect of radius:

- (1) supinator m.: inserted into the upper $\frac{1}{3}$ of the shaft (between ant. & post. oblique lines).
- (2) pronator teres: inserted into the pronator tuberosity (in the middle of the lat. surface).
- (3) brachioradialis: inserted into the lower end of the lat. surface (above the styloid process).

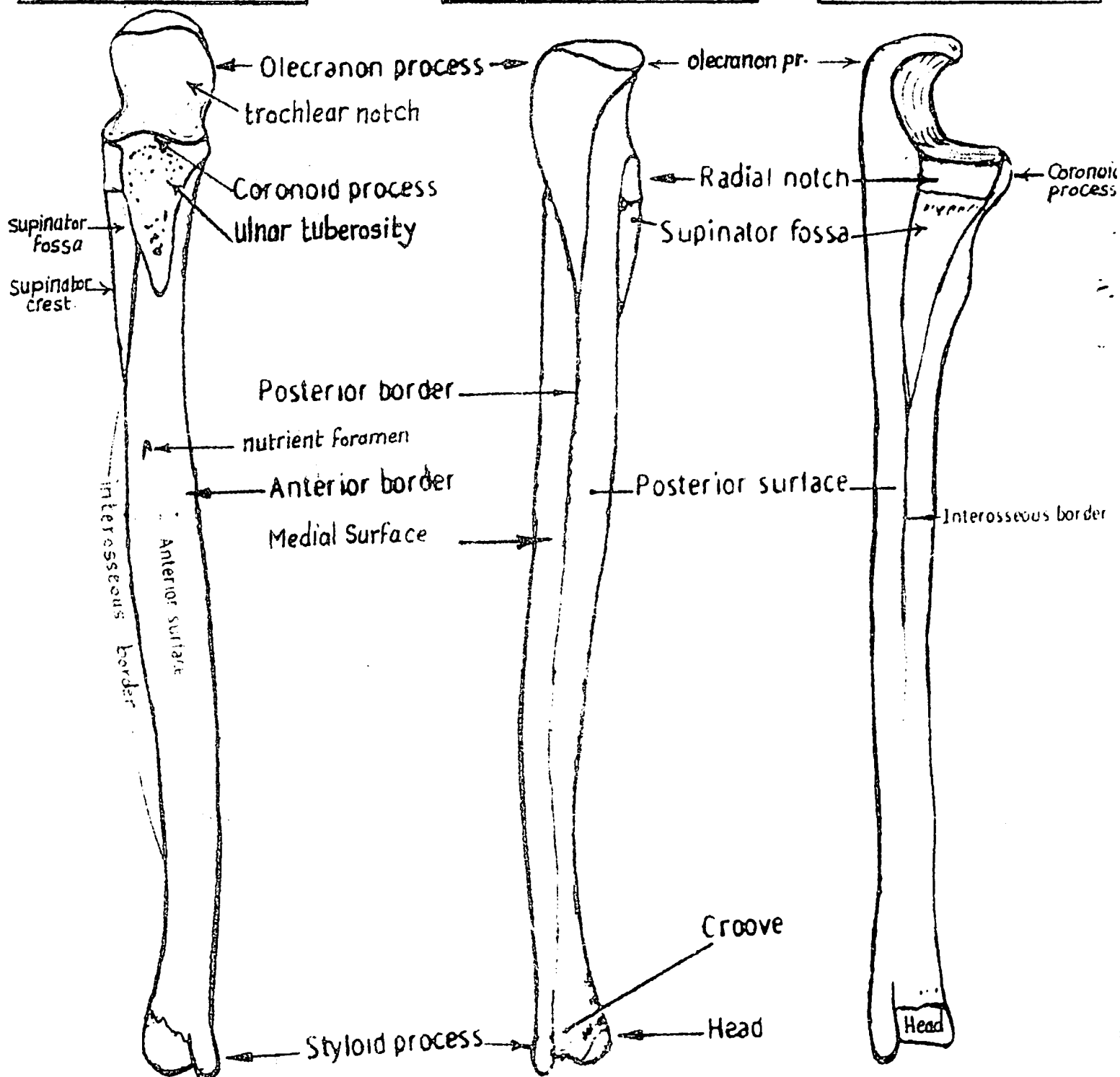
(D) 2 muscles arise from the post. surface:

- (1) abductor pollicis longus: arises from the middle $\frac{1}{3}$ of post. surface (below post. oblique line).
- (2) Extensor " brevis: " " " lower $\frac{1}{3}$ " " " (below Abd. poll. longus).

RIGHT ULNA: ANTERIOR

RIGHT ULNA: POSTERIOR

RIGHT ULNA: LATERAL



* **Type:** typical long bone. It develops by cartilagenous ossification.

* **Site:** it is the medial bone of the forearm.

* **Identification of the side (Rt. or Lt.):**

- (1) the upper end is large & hook like (trochlear notch).
- (2) the lower end is smaller & carries head & styloid process.
- (3) the concavity of the trochlear notch is directed forwards.
- (4) the lateral (interosseous) border is sharp.

* **Ossification:** see page 137.

- * it consists of a shaft & 2 ends : upper and lower .

(A) THE UPPER END

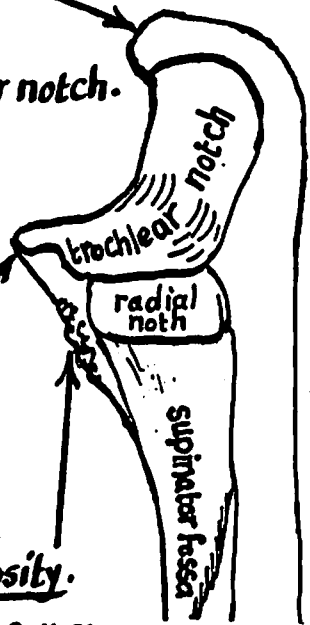
- * it is hook-shaped having: 2 processes: coronoid & olecranon .
2 notches: trochlear & radial .
2 muscular impressions: ulnar tuberosity & supinator fossa .

(1) Olecranon process:

- * forms the uppermost part of ulna & upper part of the trochlear notch.
- * it is bent forwards to form a prominent beak .
- * it lodges into the olecranon fossa of humerus (in full extension).
- * its post. part is smooth & subcutaneous .

(2) Coronoid process:

- * it projects forwards like a broad beak .
- * its upper surface forms the lower part of trochlear notch.
- * its ant. surface shows a rough area called the ulnar tuberosity .
- * its ant. border lodges into the coronoid fossa of humerus (in full flexion) .



(3) trochlear notch:

- * it is formed by the ant. surface of olecranon pr. & upper surface of coronoid pr.
- * it articulates with the trochlea of the humerus .

(4) Radial notch:

- * lies on the lat. surface of the coronoid process .
- * it articulates with the circumference of head of radius in sup. radio-ulnar joint .

(5) Ulnar tuberosity:

- * it is the rough area at the ant. surface of the coronoid process .
- * it receives the insertion of the brachialis muscle .

(6) Supinator fossa & crest:

- * it is the depressed area lying below the radial notch .
- * it is bounded posteriorly by a sharp ridge called the supinator crest .
- * the supinator fossa & crest give origin to the supinator muscle .

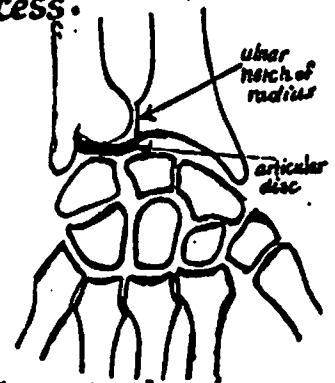
(B) THE LOWER END

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* it is smaller than the upper end & formed of head & styloid process.

(1) the head of ulna :

- * it is rounded, directed laterally & can be felt subcutaneously (in pronation).
- * its lat. surface articulates with ulnar notch of radius (in the inf. radio-ulnar joint).
- * its lat. surface is separated from the carpal bones by triangular articular disc.
- * its post. " " " from the styloid process by a groove.



(2) the Styloid process:

- * it projects downwards from the posteromedial part of the head.
- * it can be felt subcutaneously (in the supination position).

(C) THE SHAFT OF ULNA

- * it is thick above but tapers towards the lower end.
- * its upper $\frac{3}{4}$ is triangular in cross section while its lower $\frac{1}{4}$ is rounded.
- * it has 3 borders (ant., interosseous & post.) & 3 surfaces (ant., med. & post.)

(1) Interosseous border :

- * it is sharp, directed laterally & gives attachment to the interosseous membrane.
- * its upper end is continuous with the supinator crest.

(2) Anterior border :

- * it is rounded & starts above at the lower end of med. border of coronoid process.
- * it ends below at the base of the styloid process.

(3) posterior border:

- * is prominent & starts above at the apex of post. surface of olecranon process.
- * it is subcutaneous & ends below at the base of the styloid process.

(4) the Anterior surface (between the ant. & interosseous borders) :

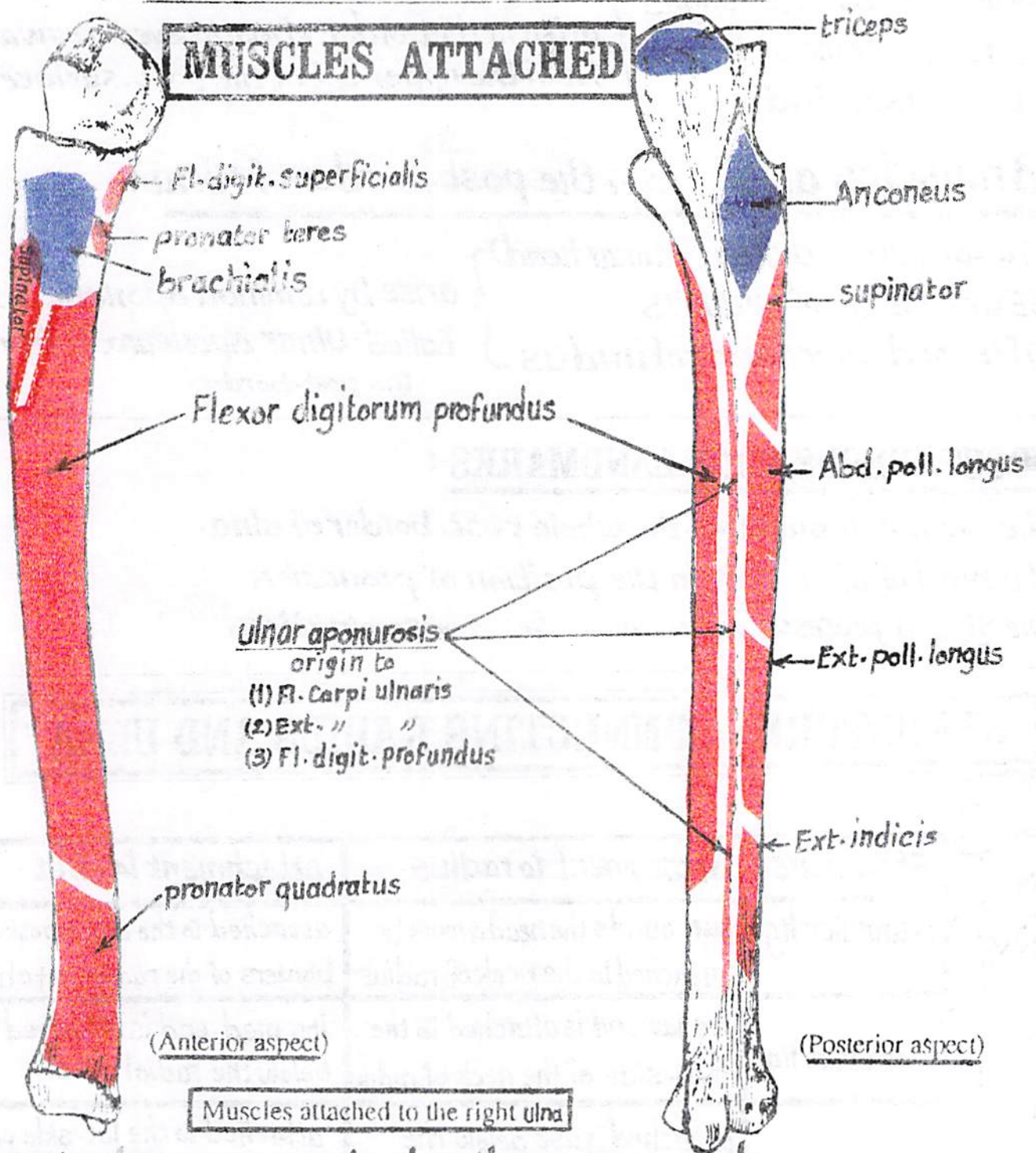
- * its upper $\frac{1}{3}$ presents a nutrient foramen (directed towards the elbow).

(5) the Medial surface (between the ant. & post. borders) :

it is smooth & featureless.

(6) the Posterior Surface : (between the interosseous & post. borders).

it may present an oblique ridge in its upper $\frac{1}{3}$ & a vertical ridge in its lower $\frac{2}{3}$.



(A) 6 muscles are attached to the upper end:

- (1) Triceps m.: inserted into the post. part of upper surface of olecranon process.
 - (2) Anconeus m.: inserted into the lat. surface of olecranon pr. & upper $\frac{1}{4}$ of post. surface.
 - (3) Brachialis m.: inserted into the ulnar tuberosity.
 - (4) Supinator m.: arises from the supinator fossa & crest.
 - (5) Flexor digitorum superficialis (ulnar head)
 - (6) pronator teres muscle (ulnar head)
- } arise from med. border of the coronoid process

(B) 2 muscles are attached to the ant. & medial surfaces:

- (1) Flexor digitorum profundus: arises from the upper $\frac{3}{4}$ of ant. & med. surfaces.
- (2) pronator quadratus: arises from the lower $\frac{1}{4}$ of the ant. surface of ulna.

(C) 3 muscles arise from the posterior surface :

30

- (1) Abductor pollicis longus
(2) Extensor pollicis longus
(3) Extensor indicis
- } arise in that order (From above downwards)
from the upper 2/3 of the post. surface.

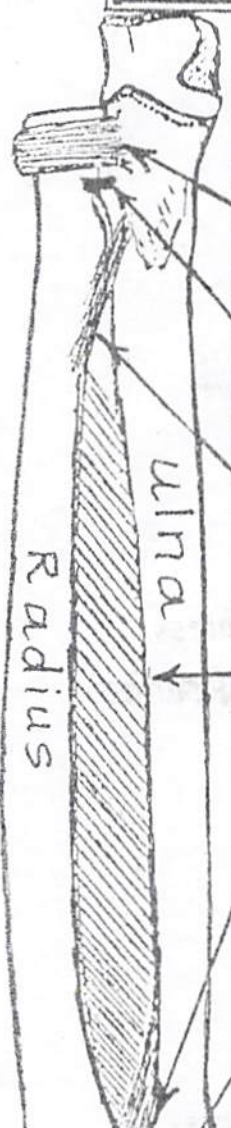
(D) 3 muscles arise from the post. border of ulna :

- (1) Flexor carpi ulnaris (ulnar head)
(2) Extensor carpi ulnaris
(3) Flexor digitorum profundus
- } arise by common aponeurosis
called Ulnar aponeurosis from
the post. border.

* SUBCUTANEOUS BONY LANDMARKS :

- (1) the olecranon process & the whole post. border of ulna.
(2) the head of ulna : felt in the position of pronation
(3) the Styloid process: " " " " " Supination.

STRUCTURES CONNECTING RADIUS AND ULNA

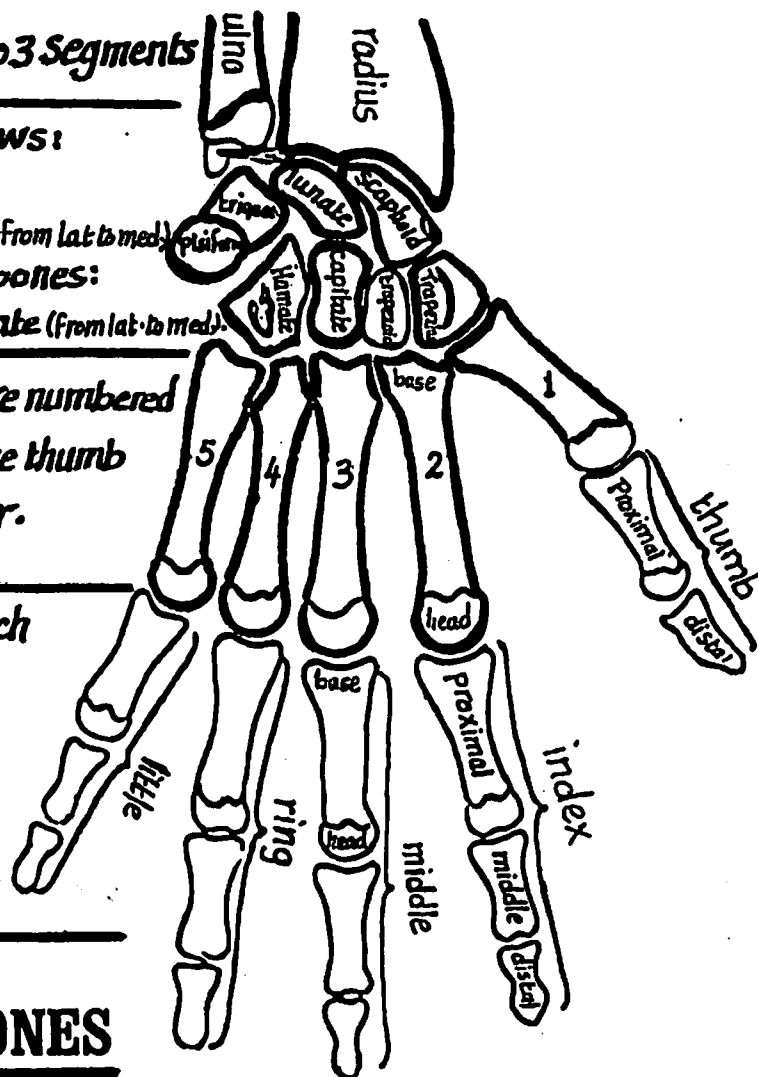


Structure	attachment to radius	attachment to ulna
1-annular lig.	surrounds the head & loosely attached to the neck of radius	attached to the ant. & post. borders of the radial notch.
2-quadrate lig.	its lat. end is attached to the med. side of the neck of radius	its med. end is attached just below the radial notch.
3-oblique cord	attached just below the radial tuberosity.	attached to the lat. side of the ulnar tuberosity below quadrate lig.
4-Interosseous membrane	attached to the interosseous border of radius	to the interosseous border of ulna
5-Capsule of inf. radio-ulnar joint	attached around the articular surfaces of the lower ends of radius & ulna.	
6-Articular disc of inf. radioulnar joint	its base is attached to inf. border of the ulnar notch of radius	its apex is attached to the depression at base of the styloid process.

N.B: the supinator & pronator teres muscles also connect the radius & ulna together.

* The Skeleton of the hand is divided into 3 segments

Carpal bones (bones of the wrist)	Consist of 8 short bones arranged in 2 rows: (A) <u>proximal row</u> : formed of 4 bones (1) scaphoid (2) lunate (3) triquetral (4) pisiform (From lat to med) (B) <u>distal row</u> : formed of the following 4 bones: (1) trapezium (2) trapezoid (3) Capitate (4) hamate (From lat to med).
metacarpals (bones of the palm)	Consist of 5 short long bones which are numbered from lat. to med. i.e the 1st belongs to the thumb while the 5th belongs to the little finger.
Phalanges (bones of the fingers)	Consist of 14 miniature long bones which are arranged as follows: (a) <u>the thumb</u> has only 2 phalanges : proximal & distal. (b) <u>each of the med. 4 fingers</u> has 3 : proximal, middle & distal.



1. CARPAL BONES

(1) Scaphoid bone : (scaphoid = boat-shaped) :

- it has a prominent tubercle which projects anterolaterally from its palmar surface
- it articulates with : (1) the radius (proximally), (2) with trapezium & trapezoid base (distally) & (3) with the lunate bone (medially).

(2) Lunate bone : (crescentic in shape) :

- it has a large ant. surface & narrow post. surface.
- it articulates with the radius proximally & with Capitate bone distally.

(3) Triquetral bone : (pyramidal in shape) :

- it articulates : (a) proximally with the articular disc of ulna, (b) distally with the hamate bone & (c) anteriorly with the pisiform bone.

(4) Pisiform bone : (pea-shaped) :

- it articulates with the palmar surface of the triquetral bone only.
- it is considered as a sesamoid bone within the tendon of flexor carpi ulnaris m.

(5) Trapezium : (quadrangular in shape) :

32

- its palmar surface is grooved (by Fl. carpi radialis tendon) & has a crest lat. to the groove.
- it articulates : proximally with scaphoid, distally with the 1st metacarpal bone & medially with trapezoid bone.

(6) Trapezoid : (irregular in shape) :

it articulates with : scaphoid (proximally), 2nd metacarpal bone (distally) & trapezium (laterally).

(7) Capitate : (bone with a head) : it is the largest carpal bone :

- proximally, its head articulates with the scaphoid & lunate bones.
- distally, it articulates with the 3rd metacarpal bone.

(8) Hamate : (bone with a hook) :

- it has a hook anteriorly (its distal aspect is related to the deep br. of ulnar n.)
- it articulates : proximally with triquetrum, distally with the 4th & 5th metacarpal bones & laterally with the capitate bone.

2. METACARPAL BONES

* They are 5 short long bones forming the skeleton of the hand.

* each metacarpal bone has a shaft & 2 ends :

- a- base (proximal end) which articulates with the distal row of carpal bones.
- b- head (distal end) which articulates with the proximal phalanx of a finger.

N.B.:- the 1st metacarpal bone is the shortest & thickest while the 2nd is the longest bone.

- when the metacarpophalangeal joints are flexed, the heads of the metacarpal bones become prominent to form the knuckles.

3. THE PHALANGES

* They constitute the bones of the fingers each of the med. 4 fingers has 3 phalanges (proximal, middle & distal) while the thumb has only 2 (proximal & distal).

* Each phalanx is a miniature long bone having a shaft & 2 ends :

(a) base (proximal end) : the base of the proximal phalanx carries an oval concave facet for articulation with the head of a metacarpal bone, while the base of the middle or the terminal phalanx carries 2 small concave facets separated by a smooth ridge

(b) head (distal end) : the head of the middle & proximal phalanx has a pulley-shaped articular surface while the head of the terminal phalanx is tapering & non-articular.

* Ossification of the bones of the hand : see page 138.

(1) THE PECTORAL REGION

* Definition: it is the region in front of the upper part of the chest :

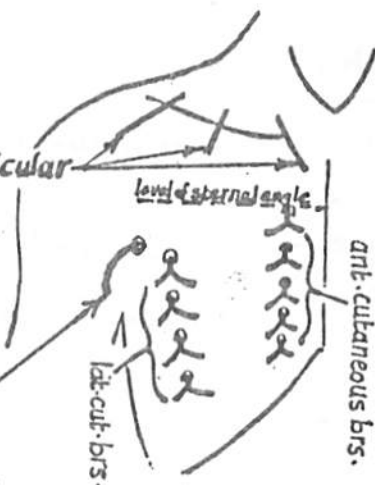
(1) THE SKIN OF THE PECTORAL REGION :

Cutaneous nerve supply :

I- the skin above the level of the sternal angle is supplied by supraclavicular nerves which are branches of the cervical plexus (C₃, C₄).

II- the skin below the level of the sternal angle is supplied by the ant. & lat. cutaneous branches of the 2nd, 3rd, 4th, 5th & 6th intercostal (thoracic) nerves.

III- the floor of the axilla is supplied by the intercostobrachial n. which is the lat. cutaneous branch of the 2nd intercostal n. (T₂).



(2) THE SUPERFICIAL FASCIA OF THE PECTORAL REGION :

(a) it is continuous with the superficial fascia of the neck, U.L. & ant. abdominal wall.

(b) it contains the following structures :

(1) the mammary gland : see the breast (page 133).

(2) platysma muscle which is a thin sheet of muscle arising from the deep fascia covering the deltoid m. & upper part of pectoralis major & extending upwards to the neck.

(3) THE DEEP FASCIA : there are 2 types of deep fascia :

(A) Pectoral fascia :

- it is a thin membrane which closely invests the pectoralis major.

- attachments : (1) above : it is attached to the clavicle

(2) medially : it is attached to the front of the sternum.

(3) below : it is continuous with the deep fascia covering the abdominal muscles & is continuous with the axillary fascia at the lower border of pectoralis major m.

(4) laterally : it is continuous with the deep fascia covering the deltoid m.

(B) Clavipectoral fascia : see page 36.

(4) MUSCLES OF THE PECTORAL REGION

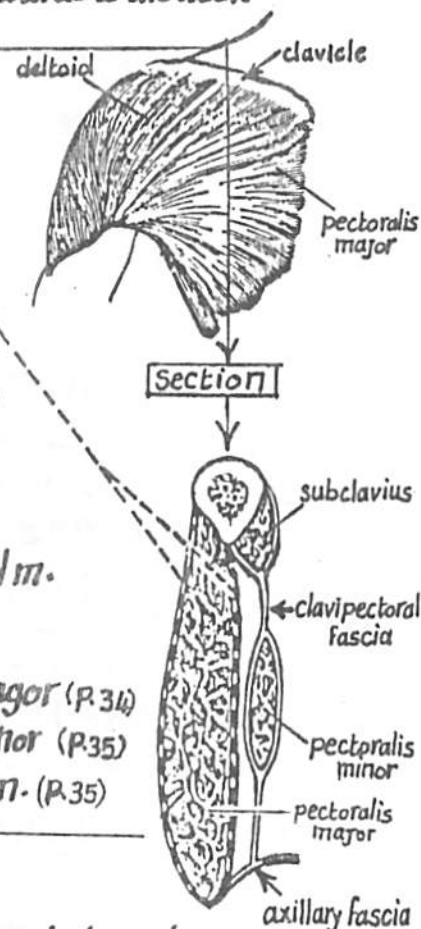
- (1) pectoralis major (P. 34)
- (2) pectoralis minor (P. 35)
- (3) subclavius m. (P. 35)

(5) Blood Supply of the pectoral region :

(A) Branches of axillary a. : the sup. thoracic, acromiothoracic & lat. thoracic branches.

(B) perforating branches of internal thoracic a. } pierce the intercostal spaces to

(C) " " " intercostal arteries } supply the front of the chest & the breast.



PECTORALIS MAJOR MUSCLE

34

* it is a huge & powerful muscle lying in front of the chest & axilla

* **Origin:** by 2 heads :

- (1) Clavicular head: from the med. $\frac{1}{2}$ of ant-surface of clavicle
- (2) Sternocostal head: from :
 - (a) ant-surface of the sternum.
 - (b) upper 6 costal Cartilages.
 - (c) external oblique aponeurosis.

* **Insertion:** by a flat bilaminar tendon into lat-lip of bicipital groove.

* **N-Supply:** medial & lat. pectoral nerves which enter the deep surface of the muscle in a reversed manner to their names.

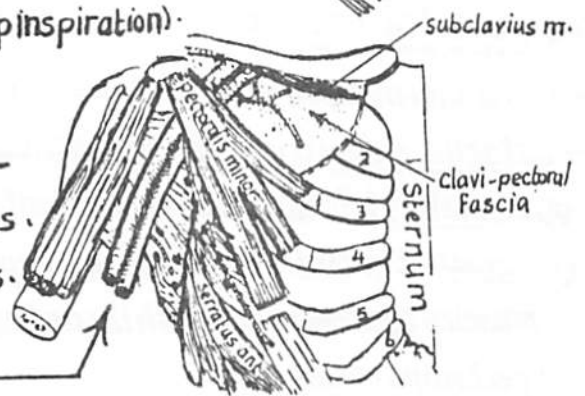
* **Action:**

- (1) Adduction & medial rotation of the arm.
- (2) the clavicular head: flexes the arm.
- (3) the Sternocostal head extends the flexed arm.
- (4) the muscle can elevate the ribs (in deep inspiration).

* **Relations:**

(A) Deep relations :

- 1 - Sternum, upper 6 ribs & their Costal Cartilages.
- 2 - pect. minor, subclavius & serratus ant. muscles.
- 3 - Clavipectoral fascia.
- 4 - Axilla and its Contents



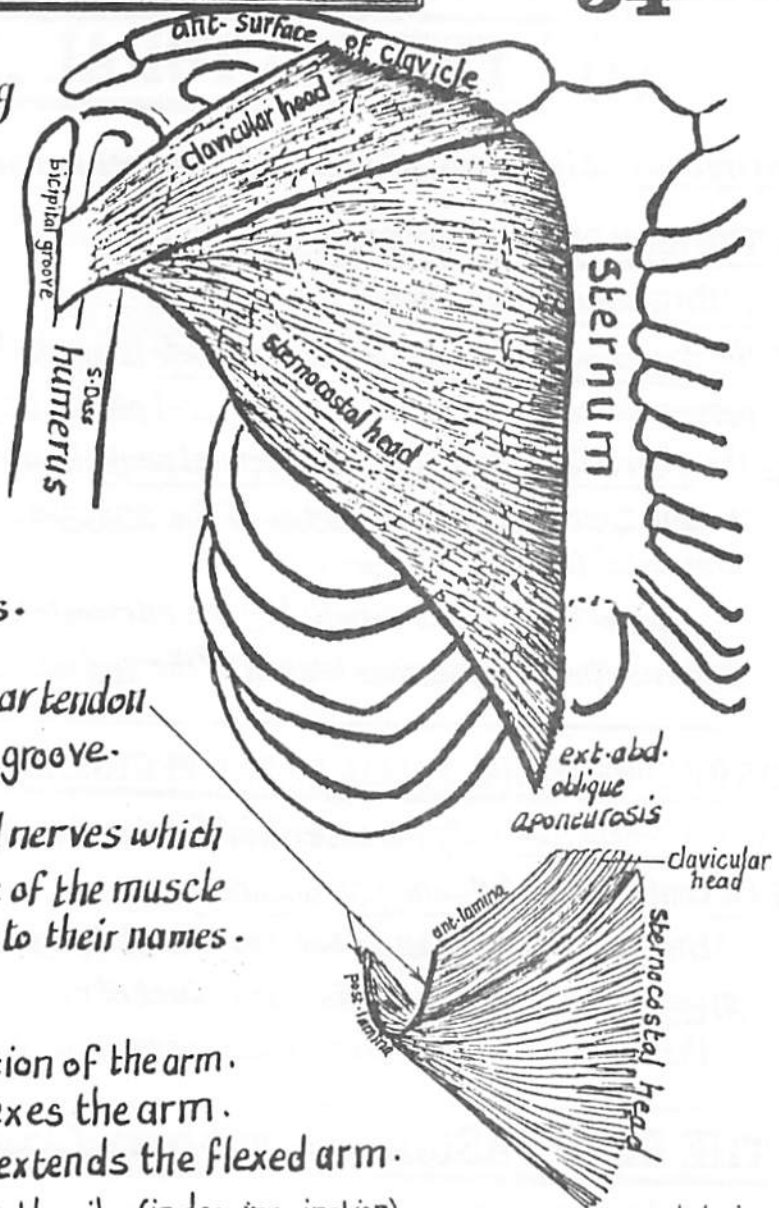
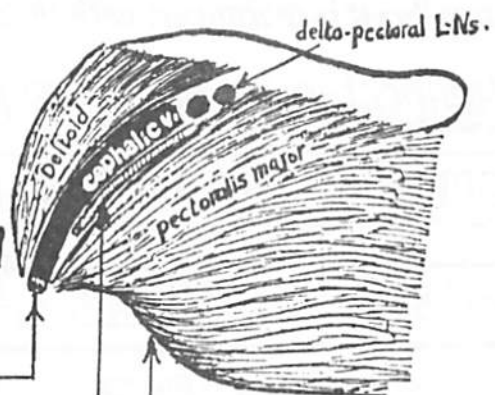
(B) Superficial relations:

- 1- skin & superficial fascia containing platysma muscle & supraclavicular nerves.
- (2) the breast (3) deep (pectoral fascia).

(C) Its upper border: is separated from deltoid by the delto-pectoral groove which contains

- (1) upper part of the cephalic v.
- (2) deltoid br. of thoraco-acromial a.
- (3) delto-pectoral lymph nodes.

(D) Its lower border: forms the ant-axillary fold



PECTORALIS MINOR MUSCLE

35

* it is a small triangular m. lying behind the middle $\frac{1}{3}$ of pectoralis major.

* Origin: from the 3rd, 4th & 5th ribs just lat. to their cartilages.

* Insertion: into the med. border & upper surface of coracoid process of scapula.

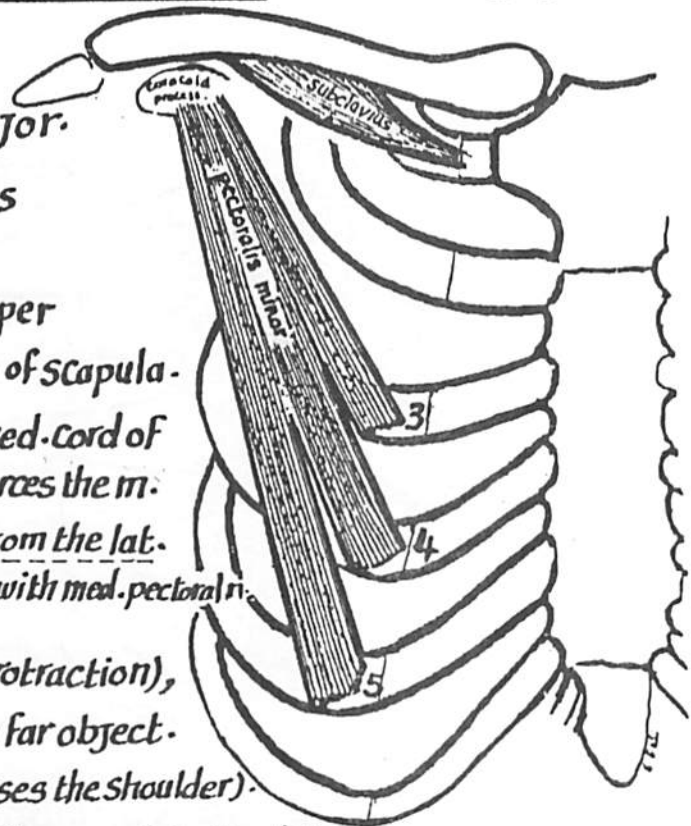
* N. Supply: med. pectoral n. (from the med. cord of the brachial plexus) which pierces the m.

N.B: the muscle also receives few fibres from the lat. pectoral n. through its communication with med. pectoral n.

* Action: (1) pulls the scapula forwards (protraction), thus stretching the arm to reach a far object.
(2) depresses the scapula (depresses the shoulder).

(3) acting from its insertion (when the scapula is fixed) it can raise the ribs as in forced inspiration.

* Important relations: (a) ant. relations: pectoralis major m. & lat. pectoral n. pectoral br. of thoraco-acromial a.
(b) - deep relations: 2nd part of axillary a., axillary v. & cords of the brachial plexus.
(c) - its upper border: is attached to the clavipectoral fascia & related to the structures piercing it.
(d) - its lower border: is related to the lat. thoracic vessels & ant. group of axillary L.Ns.



SUBCLAVIUS MUSCLE

* it is a small muscle lying immediately below the clavicle.

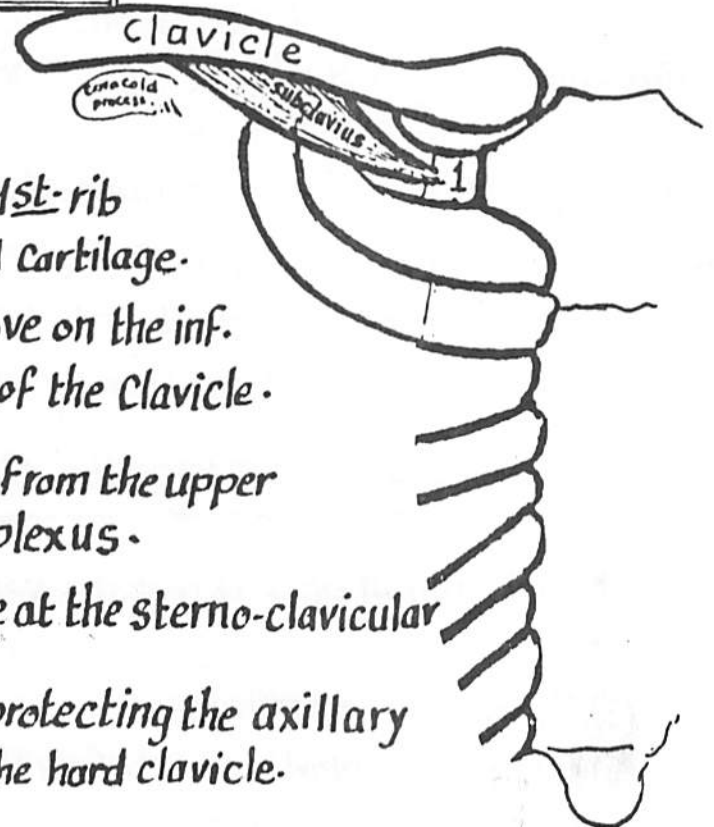
* Origin: from the upper surface of the 1st rib at its junction with its costal cartilage.

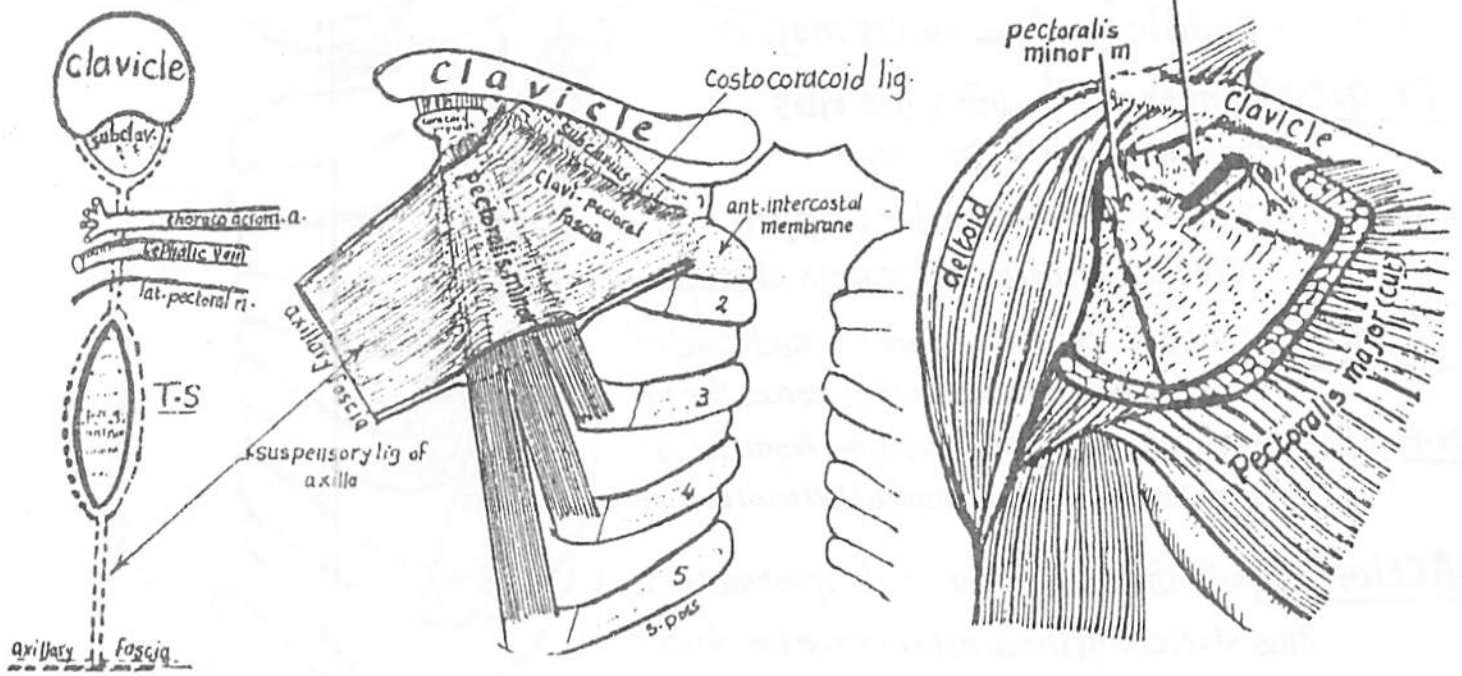
* Insertion: into the subclavius groove on the inf. surface of the middle $\frac{1}{3}$ of the clavicle.

* N. Supply: n. to subclavius (C5, 6) from the upper trunk of the brachial plexus.

* Action: (1) it steadies the clavicle at the sterno-clavicular joint.

(2) it acts as a soft pad protecting the axillary vessels & nerves from the hard clavicle.





*** Definition :** it is a strong fibrous membrane of deep fascia filling the gap between pectoralis minor & the clavicle. It lies behind the clavicular head of pectoralis major. It covers the axillary vessels & cords of brachial plexus.

*** Attachments:**

- (1) above : the fascia splits to enclose the subclavius m. & then becomes attached to the lips of the subclavius groove of the clavicle.
- (2) below : it splits to enclose the pectoralis minor m. then proceeds downwards (as the suspensory lig. of axilla), to be attached to the deep fascia of the floor of axilla (it is responsible for the hollow of the armpit).
- (3) medially : it is attached to the 1st & 2nd costal cartilages & the ant. interosseous membrane in between.
- (4) laterally : it is attached to the coracoid process & the Coraco-clavicular lig.

N.B : the part of the clavipectoral fascia which lies just below the subclavius m. is thickened band extending along the lower border of the muscle from the 1st rib medially to coracoid process laterally & is called the CostoCoracoid ligament.

*** Structures piercing the Clavi-pectoral fascia :**

- (1) the terminal part of cephalic v. (passing deeply to join the axillary v.).
- (2) the lateral pectoral n. (passing superficially to enter pectoralis major m.).
- (3) the thoraco-acromial a. (» » then divides into 4 terminal brs.).
- (4) efferent lymphatic vessels from the infra-clavicular L.Ns (passing deeply to end in the apical group of axillary L.Ns.).

* It is a fan-shaped muscle covering the upper part of the side of the chest.

* **Origin:** arises by 8 digitations from the outer surfaces of the upper 8 ribs midway between their angles & their Costal Cartilages.

N.B.: (1) the 1st digitation arises from the 1st & 2nd ribs.

(2) the lower 4 digitations interdigitate with the external abdominal oblique muscle.

* **Insertion:** into the ventral lip of the med. border of the scapula as follows:

(1) the 1st digitation: inserted into the ventral aspect of the sup. angle.

(2) the 2nd & 3rd digitations: inserted into the whole length of ventral aspect of med. border.

(3) the lower 5 digitations: (the largest & most important part) converge to be inserted into the ventral aspect of inf. angle.

* **Nerve supply:** n. to serratus ant. (long thoracic n. or nerve of Bell) from the roots C5, 6, 7 of the brachial plexus.

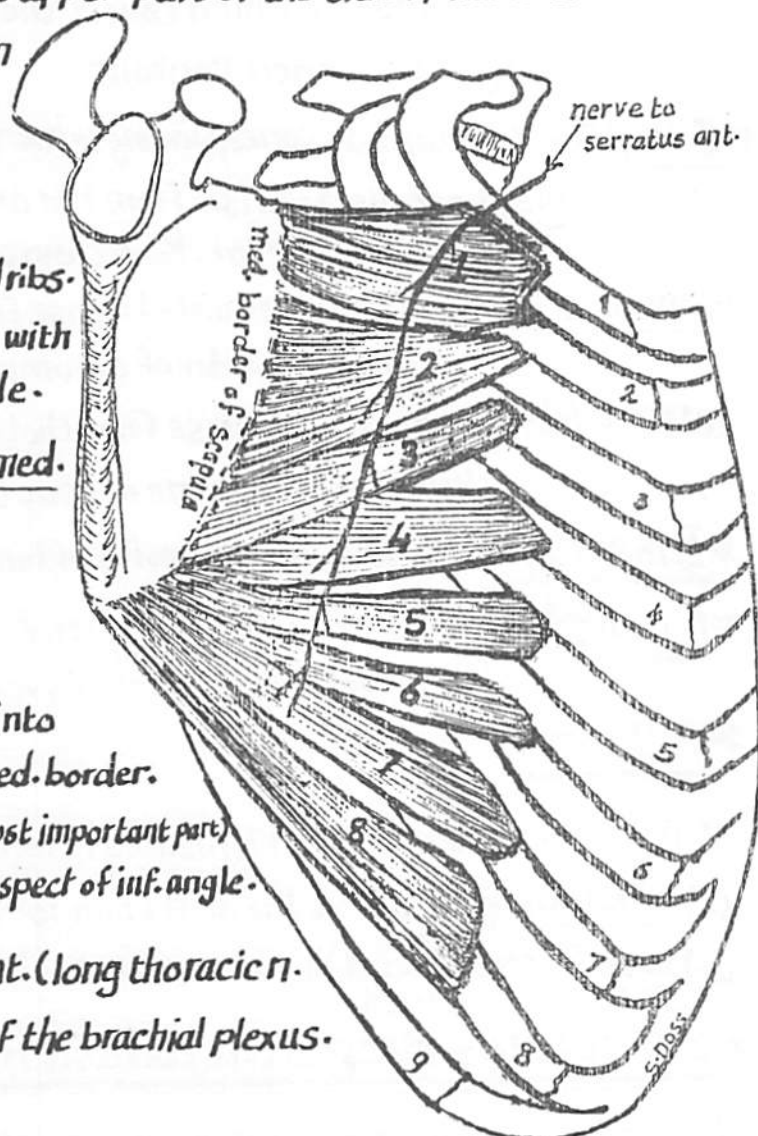
* **Action:**

- (1) it pulls the scapula forwards (it is the most powerful protractor).
- (2) fixation of the scapula on the chest wall (its paralysis leads to winging of the scapula).
- (3) the lower 5 digitations pull the inf. angle of the scapula so that the glenoid cavity faces upwards (as in raising the arm above the head).
- (4) acting from its insertion, the muscle can elevate the ribs (as in forced inspiration).

* **Important relations:**

- (1) it enters in the formation of the medial wall of the axilla.
- (2) its 1st digitation lies behind the 1st part of axillary a. & the med. cord of br. plexus.
- (3) the n. to serratus ant. descends vertically on its outer surface in the midaxillary line.
- (4) the lat. cut. branches of the intercostal nerves emerge between the digitations of the muscle.

* **Clinical importance:** paralysis of serratus ant. leads to "Winging of scapula" (the med. border projects backwards like a wing).



DELTOID MUSCLE

* It is a thick Δ muscle which covers the shoulder region giving it a rounded contour.

* Origin: V-shaped (Corresponding to insertion of trap.)

(1) ant. fibres (parallel): arise from the ant. aspect of the lat. $\frac{1}{3}$ of clavicle.

(2) middle fibres: (multipennate): arise from the lat. border of acromion.

(3) post. fibres: (parallel): arise from the lower lip of crest of spine of scapula.

* Insertion: into deltoid tuberosity of humerus.

* N. Supply: Circumflex (axillary) n. C5, 6 from post. cord of brachial plexus

* Action:

(1) ant. fibres: flex the arm & rotates it medially.

(2) middle fibres: abduct the arm from 15° to 90° .

(3) post. fibres: extend the arm & rotates it laterally.

* Structures deep to the deltoid m.:

(1) Coraco-acromial lig., arch & subacromial bursa.

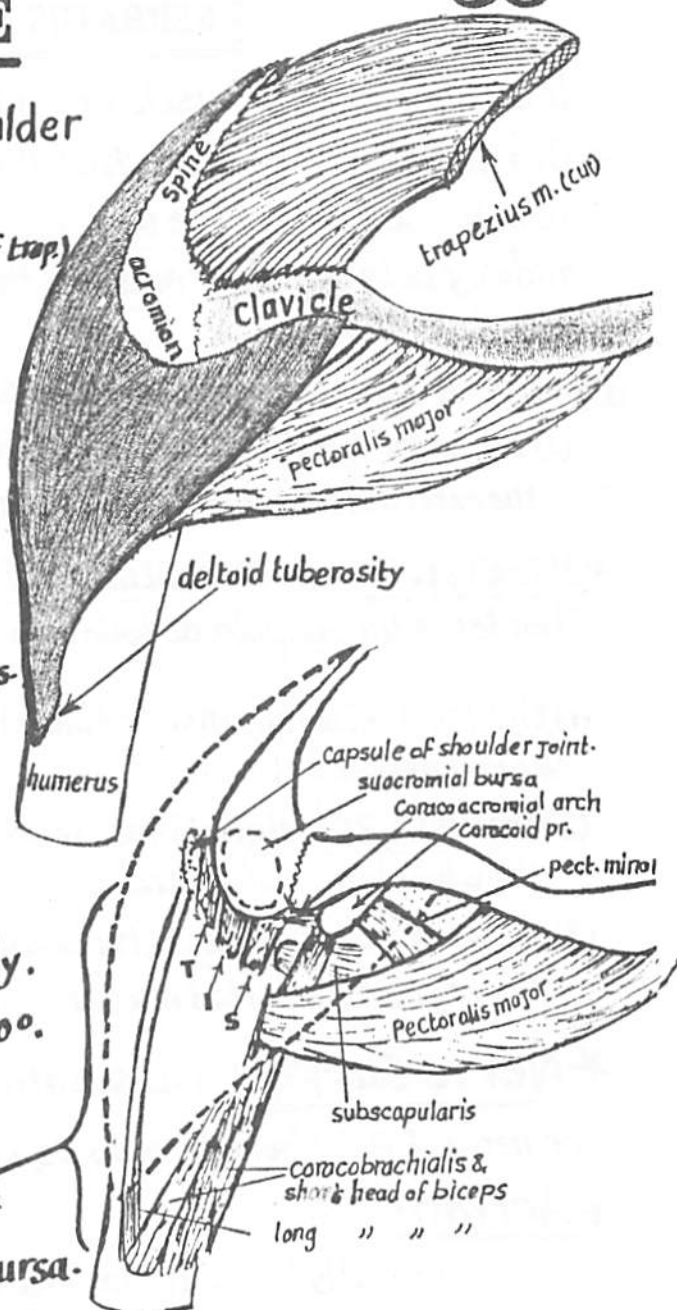
(2) Coracoid process & muscles attached to it (pect. minor, coracobrachialis & biceps).

(3) muscles inserted into the greater tuberosity (supraspin., infraspin. & teres minor).

(4) the subscapularis m. inserted into lesser tuberosity.

(5) tendons of pectoralis major & long head of biceps.

(6) Capsule of shoulder joint.



TRAPEZIUS MUSCLE

* it is a large triangular m. extending from the back of skull to the back of thorax.

* Origin: extensive; from 3 areas:

(1) back of skull: from med. $\frac{1}{3}$ of sup. nuchal line + the external occipital protuberance

(2) " " neck: from the ligamentum nuchae + the spine of C7

(3) " " thorax: from all thoracic spines & supraspinous ligaments.

* **Insertion** : V-shaped (opposite the origin of deltoid):

(1) **Upper fibres** (occipital & upper cervical) : are inserted into the post. aspect of lat $\frac{1}{3}$ of clavicle

(2) **middle fibres** (lower cervical & upper thoracic) : are inserted into med. border of acromion & upper lip of the crest of spine of scapula.

(3) **lower fibres** : ascend to be inserted by a tendon into the tubercle of the crest of spine of scapula.

* **N. Supply** : (1) **Motor** : spinal accessory n.

(2) **Sensory** (proprioceptive) : branches from C₃, 4

N.B : trapezius is the only m. in U.L. not supplied by brachial plexus

* **Deep relations** : (rest of muscles of the back + artery + nerve):

- levator scapulae, rhomboids, lat. dorsi, supra & infraspinatus m.

- Spinal accessory n. & superficial br. of transverse cervical a.

* **Action** :

(1) **upper fibres** : elevate the scapula & shoulder (shrug the shoulder).

(2) **middle** : retract the scapula (position of standing at attention of soldiers).

(3) **lower** : rotates the scapula so that the glenoid cavity faces upwards.

(4) acting from its insertion, trapezius pulls the head backwards & laterally.

LATISSIMUS DORSI MUSCLE

* It is a wide flat muscle which covers the lower $\frac{1}{2}$ of the back (extending down to the iliac crest).

* **Origin** : by an aponeurosis from :

(1) the lower 6 thoracic spines & supraspinous ligaments (under cover of trapezius m.)

(2) from the lumbar spines (through thoracolumbar fascia)

(3) from the post. part of outer lip of the iliac crest.

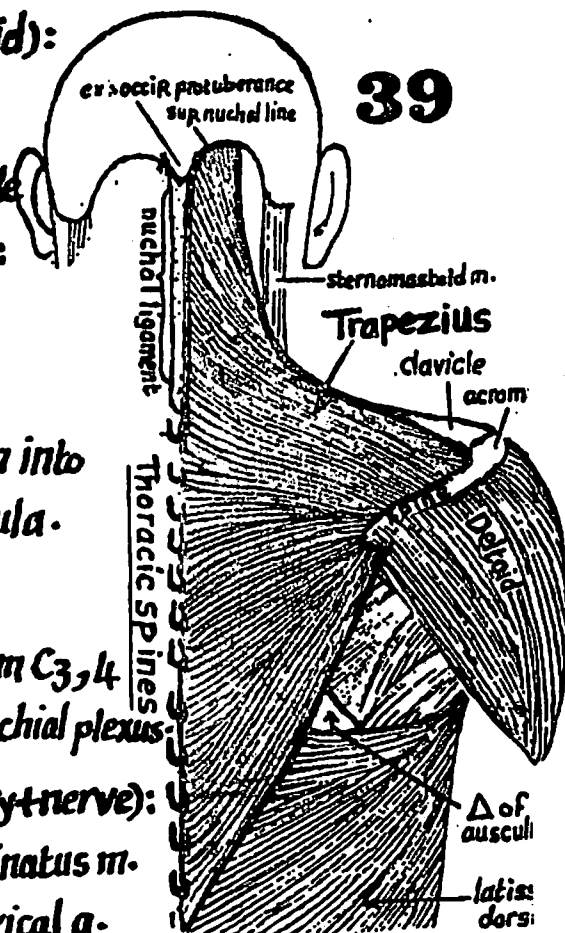
(4) outer surfaces of lower 3 or 4 ribs.

(5) dorsal aspect of inf. angle of the scapula

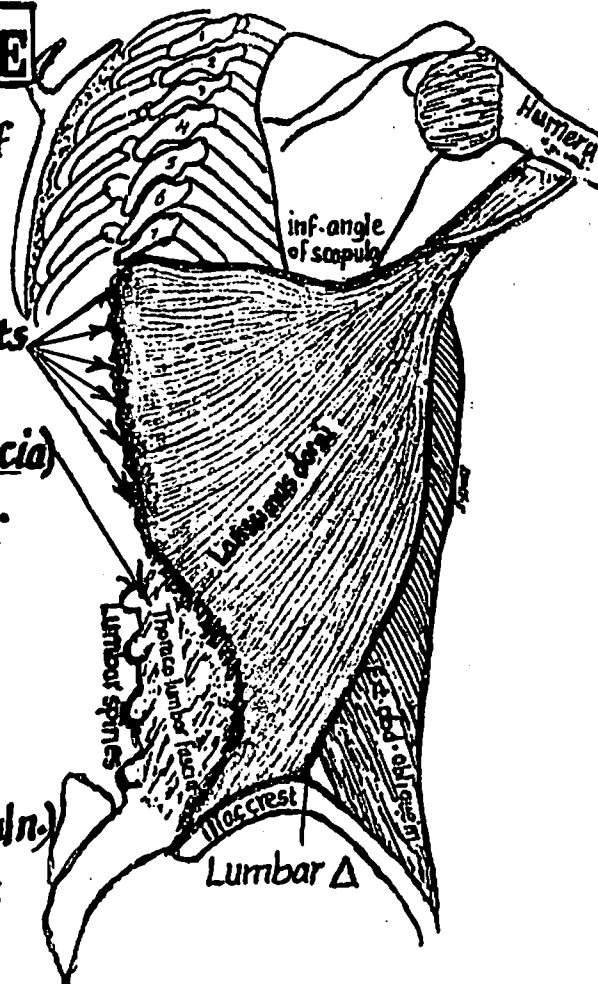
* **Insertion** : by a flat tendon into the floor of the bicipital groove of the humerus.

* **N. Supply** : nerve to latissimus dorsi (thoracodorsal n.) from the post. cord of brachial plexus

N.B : it enters the muscle with the thoracodorsal artery.



39



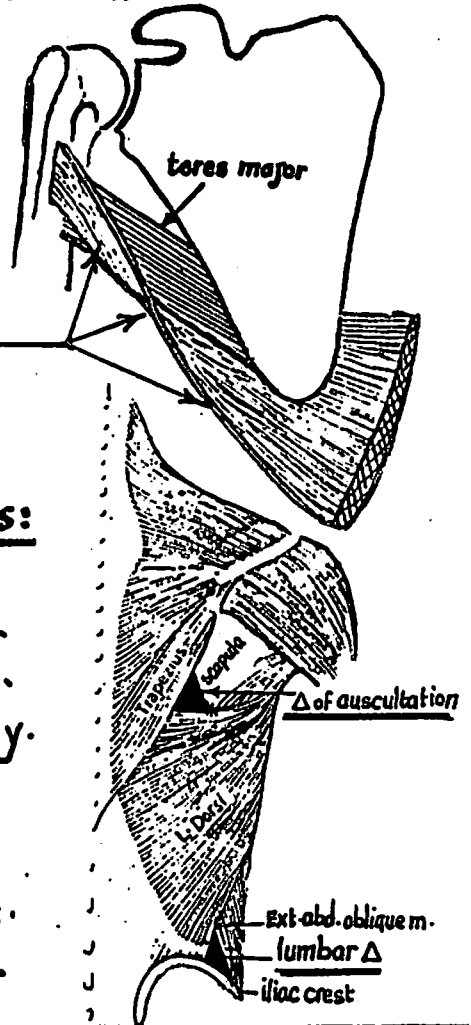
*Action:

40

- (1) extension, adduction & med. rotation of the arm.
- (2) it pulls the whole shoulder girdle downwards & backwards (as in swimming).
- (3) it can pull the trunk upwards when the arms are fixed above the head (as in climbing).
- (4) it is a strong m. of expiration as it can compress the lower part of the thoracic cage.

*Important relations :

- (1) the tendon of L. Dorsi has a triple relation with teres major m. : being 1st behind teres major, then below it & finally in front of teres major at its insertion.
- (2) Latissimus dorsi enters in the formation of 2 triangles:
 - (A) Δ of auscultation: bounded by
 - (1) lower fibres of trapezius : ----- above.
 - (2) upper " " L. dorsi : ----- below.
 - (3) med. border of scapula : ----- laterally.
 - (4) Floor is formed by rhomboideus major m.
 - (B) lumbar Δ : bounded by:
 - (1) iliac crest ----- below.
 - (2) external abd. oblique m. ----- in front.
 - (3) latissimus dorsi ----- behind.



LEVATOR SCAPULAE MUSCLE

*Origin: from the upper 4 cervical transverse processes.

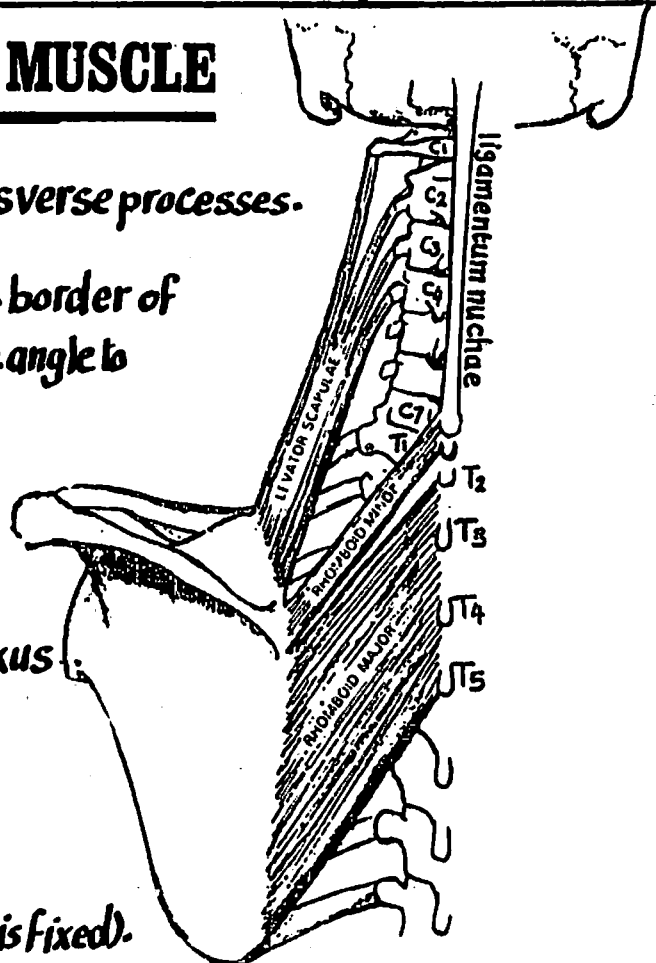
*Insertion: into dorsal aspect of med. border of scapula extending from sup. angle to the root of the spine

*N. Supply:

- (1) C₃, C₄ (from the cervical plexus)
- (2) n. to rhomboids (C₅): from brachial plexus.

*Action:

- (1) elevates the scapula & fixes it.
- (2) rotates the scapula downwards.
- (3) lat. flexor of the neck (when scapula is fixed).



* Origin: lower part of ligamentum nuchae & spines of C7 & T₁.

* Insertion: into dorsal aspect of med. border of scapula opposite the root of spine.

RHOMBOIDEUS MAJOR M.

* Origin: spines of the 2nd, 3rd, 4th & 5th thoracic vertebrae & supraspinous ligaments.

* Insertion: into dorsal aspect of med. border of scapula extending from the root of spine to the inf. angle.

* N. Supply of the 2 rhomboids: n. to rhomboids (dorsal scapular n.) from C5

* Action " " " " " : (1) retraction of scapula
(2) downward rotation of the scapula.

SUPRASPINATUS MUSCLE

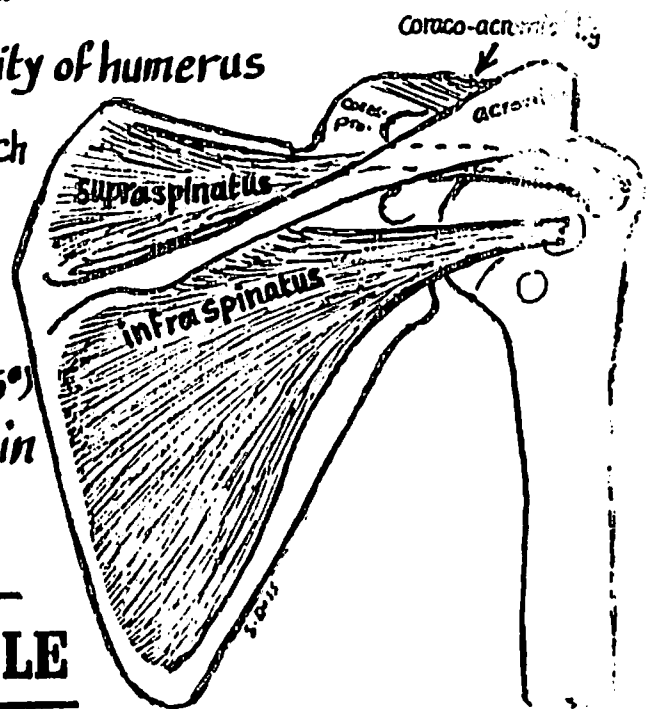
* Origin: med. 2/3 of supraspinous fossa of scapula.

* Insertion: uppermost facet of greater tuberosity of humerus

N.B: its tendon passes deep to the coracoacromial arch & separated from it by the subacromial bursa.

* N. Supply: Suprascapular n.

* Action: (1) abduction of the arm (from 0° to 15°)
(2) helps to keep the head of humerus in the glenoid cavity during the action of other muscles.



INFRASPINATUS MUSCLE

* Origin: (1) med. 2/3 of the infraspinous fossa.
(2) From the fascia covering the muscle.

* Insertion: into the middle facet of the greater tuberosity of humerus.

* N. supply: suprascapular n. (from upper trunk of brachial plexus).

* Action: (1) adduction of the arm.
(2) lateral rotation of the arm.
(3) helps to steady the shoulder joint.

TERES MINOR MUSCLE

42

* Origin: upper 2/3 of dorsal aspect of lat. border of scapula

N.B: its origin is traversed by the circumflex scapular a.

* Insertion: lower most facet on the back of greater tuberosity of humerus

* N. Supply: axillary (circumflex) n.: from its post-division.

* Action:

- (1) lateral rotation of the arm.
- (2) adduction of the arm.
- (3) helps to steady the shoulder joint

TERES MAJOR M

* Origin: from an oval area on the lower 1/3 of dorsal aspect of lat. border of scapula

* Insertion: into med. lip of bicipital groove of the humerus.

* N. Supply: lower subscapular n.

(From the post. cord of the brachial plexus).

* Action: (1) adduction of the arm.

(2) med. rotation of the arm.

(3) extension of the arm.

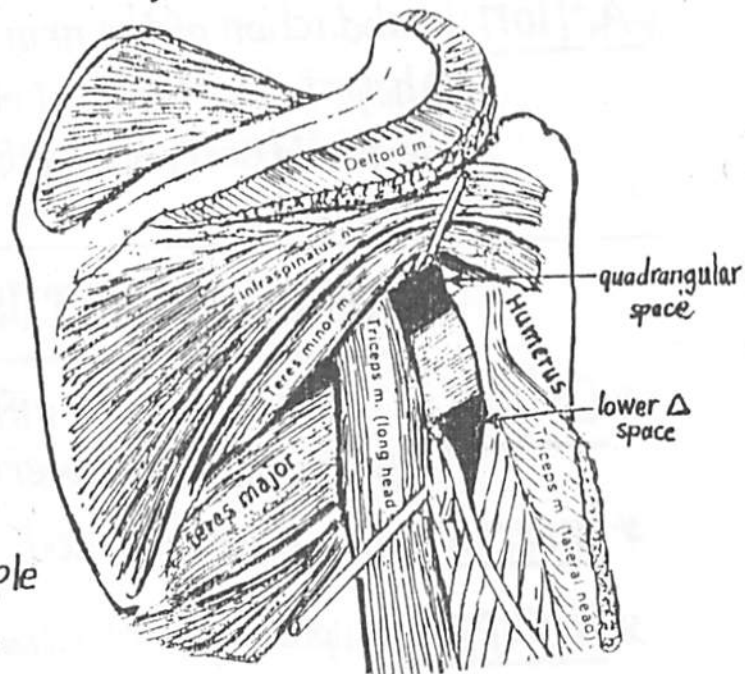
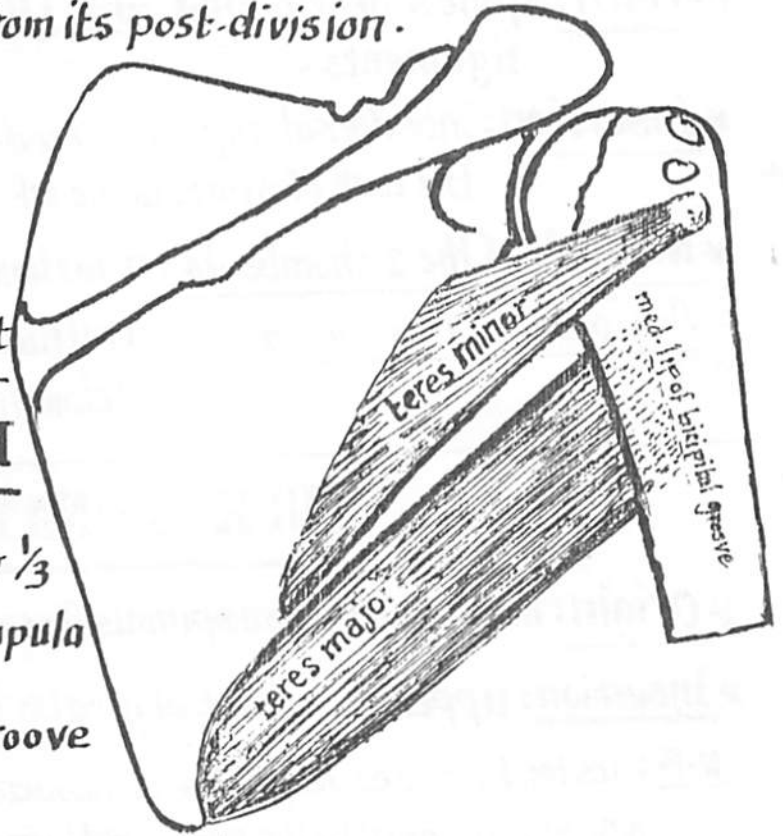
* Relations:

(1) its tendon forms the lower boundary of the quadrangular, upper triangular spaces & the upper boundary of the lower Δ space

(2) the tendon of latissimus dorsi m. has a tripple relation with teres major (see page 40).

(3) the lower border of teres major is the lower limit of axilla.

(4) both teres major & l. dorsi form the post-axillary fold } see axilla (page 45).



SUBSCAPULARIS M

43

(it is a thick triangular multipennate muscle)

* **Origin:** med. 2/3 of subscapular fossa of scapula.

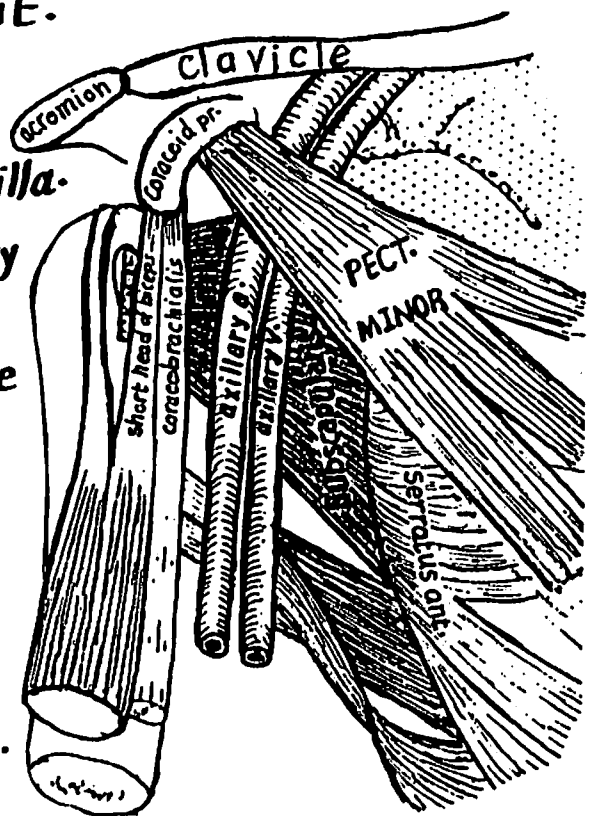
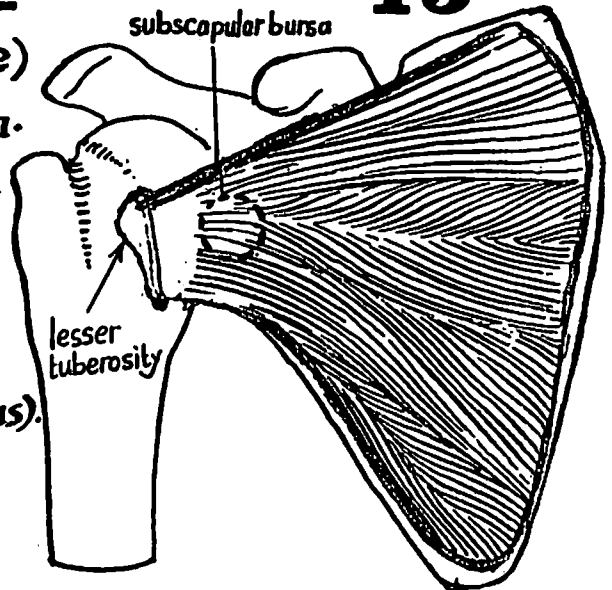
* **Insertion:** into the lesser tuberosity of humerus
& extending for 1/2 an inch on the shaft.

* **N. supply:** upper & lower subscapular nerves
(from the post. cord of the brachial plexus).

* **Action:** (1) adduction of the arm.
(2) med. rotation of the arm.
(3) helps to steady the shoulder joint.

* Important relations:

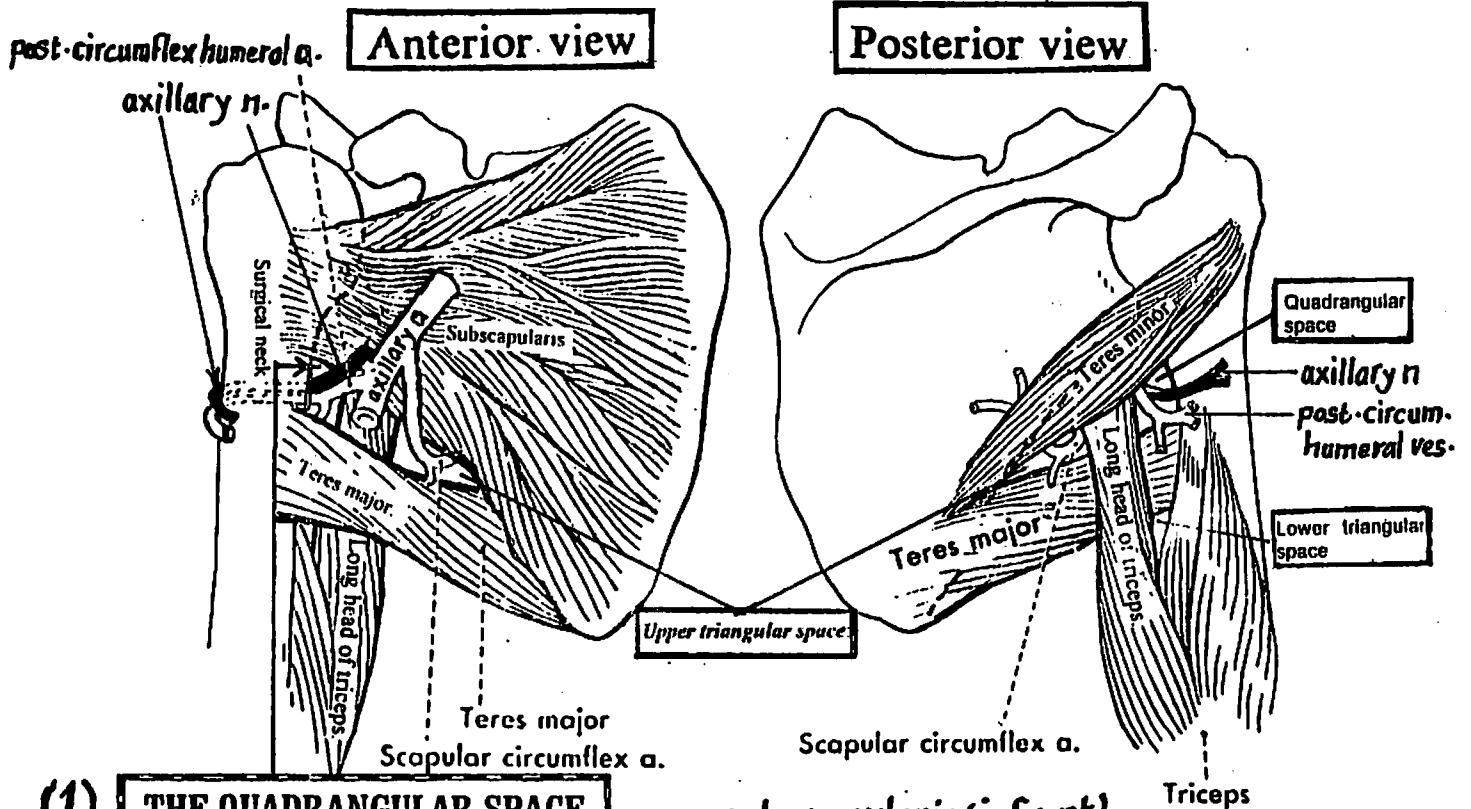
- (1) the muscle forms the upper part of post-wall of axilla.
- (2) it is separated from the serratus ant. by the cavity of the axilla.
- (3) its lat. part is separated from the capsule of the shoulder joint by the subscapular bursa & is crossed superficially by the axillary vessels & the cords of the brachial plexus
- (4) its tendon passes to its insertion behind an arch formed by the coracoid process & the common origin of Coracobrachialis & short head of biceps.



THE ROTATOR CUFF

* **definition:** it is the name given to the subscapularis, supraspinatus, infraspinatus & teres minor (i.e. muscles inserted in the greater & lesser tuberosities because their tendons surround the shoulder joint & blend with its fibrous capsule, like a cuff, from above, behind & in front).

* **Importance:** these muscles reinforce the capsule of the shoulder joint & provide an active support to it during movements by pulling the head of humerus medially towards the glenoid cavity.



(1) THE QUADRANGULAR SPACE

- * Boundaries :
- (1) superiorly :
 - subscapularis (in front).
 - teres minor (behind).
 - capsule of shoulder joint (in between).
 - (2) inferiorly : teres major m.
 - (3) laterally : surgical neck of humerus.
 - (4) medially : long head of triceps.

* Contents :

- (1) circumflex (axillary) nerve
 - (2) post-circumflex humeral vessels
 - (3) fold from the capsule of shoulder joint.
- } pass from before backwards

* Importance : this space adds to the weakness of the shoulder joint & the liability of its dislocation & the injury of the axillary nerve.

(2) THE UPPER TRIANGULAR SPACE

- * Boundaries :
- (1) superiorly :
 - subscapularis m. (in front).
 - teres minor muscle (behind).
 - lat. border of scapula (in between).
 - (2) inferiorly : teres major m.
 - (3) laterally : long head of triceps.

* Contents : circumflex scapular a.

(3) THE LOWER TRIANGULAR SPACE

- * Boundaries :
- superiorly : teres major.
 - medially : long head of triceps.
 - laterally : shaft of humerus (spiral groove).
- * Contents : radial n. & profunda vessels.

THE AXILLA

45

*Definition:

the axilla or armpit is a hollowed out pyramidal-shaped space at the junction between the arm & the trunk.

*Site:

it lies obliquely between the upper part of the arm & the upper part of the side of the chest. It is situated just above the armpit.

*Shape:

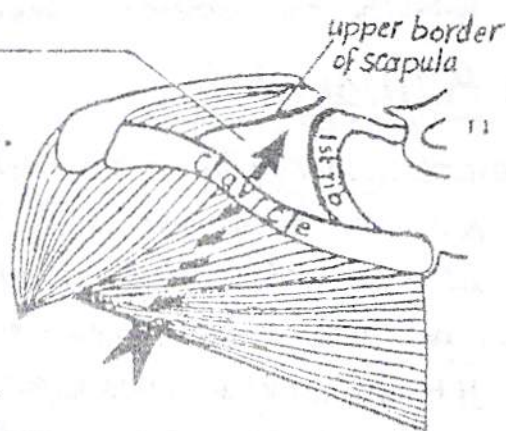
it is pyramidal in shape, having apex, base & 4 walls (ant., post., med. & lateral).

(A) Apex of the axilla:

- it lies in the upper part & is directed upwards & medially.
- it connects the axilla with the post. triangle of the neck (it is called the cervico axillary canal).
- it is narrow & triangular in outline & is bounded by:

- (1) the middle $\frac{1}{3}$ of the clavicle --- anteriorly.
- (2) the upper border of scapula --- posteriorly.
- (3) the outer border of the 1st rib --- medially.

- it transmits the axillary vessels & cords of the brachial plexus from the root of the neck to the axilla.



(B) Base (floor) of the axilla:

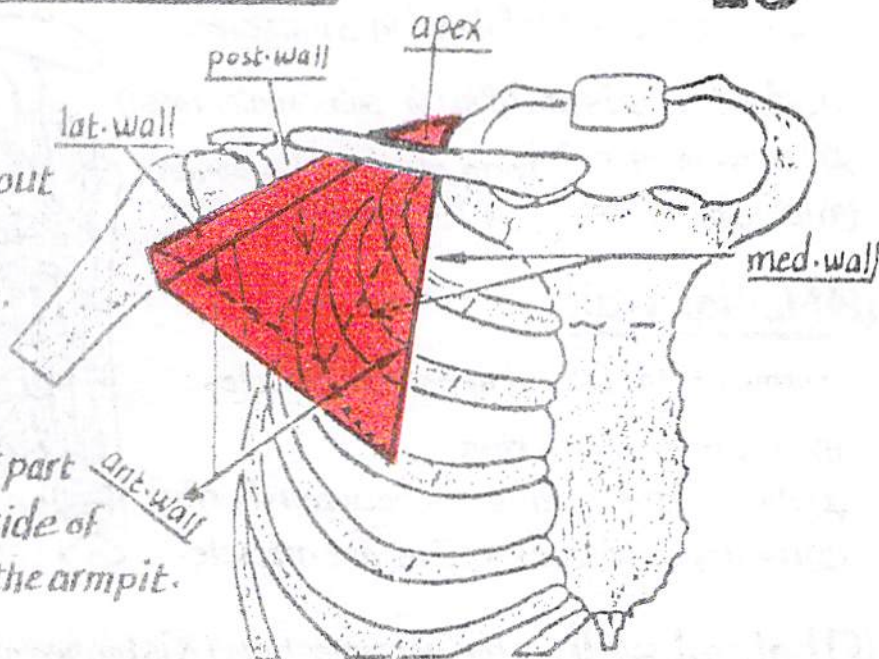
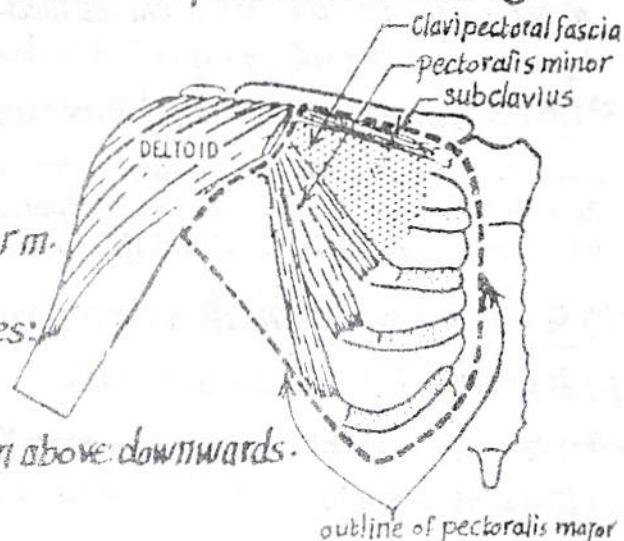
- it forms the lower wall of the axilla & is directed downwards & laterally.
- it is formed by the skin & fascia of the armpit (axillary fascia).
- the axillary fascia is connected above to the lower border of pectoralis minor by the suspensory ligament of the axilla.

(C) Anterior wall: consists of 2 layers:

(1) Superficial layer: formed by pectoralis major m.

(2) deep layer: formed of the following 3 structures:

- (a) subclavius muscle
 - (b) Clavipectoral fascia
 - (c) Pectoralis minor m.
- arranged from above downwards.



(D) Posterior wall: is longer & wider than the ant. wall.

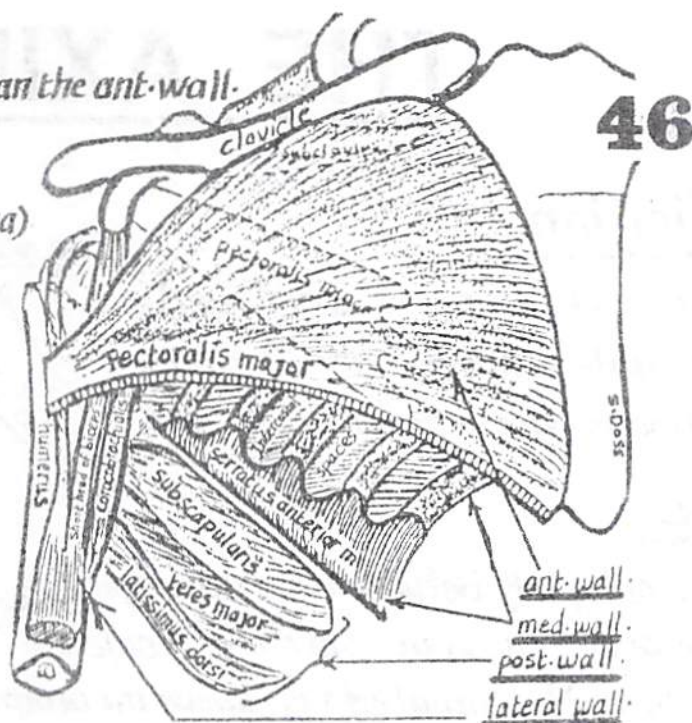
- it is formed of the following 3 muscles:

- (1) *Subscapularis m.* (filling the subscapular fossa)
 (2) *teres major m.* } lying along the lat. border
 (3) *latissimus dorsi.* } of the scapula.

(E) Medial wall :

Formed of the following bones & muscles:

- (1) the upper 4 or 5 ribs
- (2) the intercostal muscles between the ribs.
- (3) the upper part of serratus ant. muscle.



(F) Lateral wall: is the narrowest wall & is formed of the following bone & muscles:

- (1) upper part of the humerus (2) short head of biceps m. (3) coracobrachialis

N.B: the main vessels & nerves of the axilla are related to the lateral wall.

* Axillary folds:

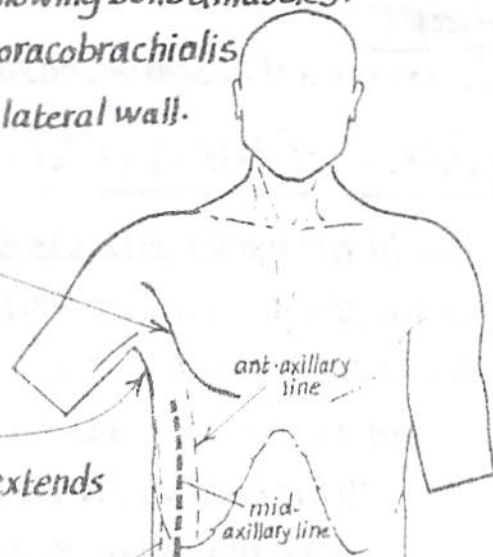
- (1) ant-axillary fold : is the lower border of ant-wall of axilla
& is formed by the lower border of pectoralis major m. alone.

Its downward continuation is called the ant-axillary line.

- (2) Post. axillary fold: is the lower border of post. wall of axilla.

It is formed by both *teres major* & *latissimus dorsi* muscles & it extends lower down than the ant-axillary fold.

- a line drawn as a downward continuation of the post-fold is called the post-axillary line.



N.B: the midaxillary line lies midway between the ant. & post. axillary lines.

* Contents of the axilla: it is filled with axillary fat & contains the following structures:

- (1) axillary a. & its branches: it enters the axilla through its apex then runs along its lat. wall to end at the lower border of teres major m. by becoming the brachial a. It gives 6 branches in the axilla (it is described in detail on page 75).

- (2) axillary v. & its tributaries: it enters the axilla from below (at the lower border of teres major) then runs upwards along the med. side of the axillary a. It leaves the axilla at its apex by becoming the subclavian v. (it is described in detail on page 89).

- (3) Cords & branches of the br. plexus: are arranged around the axillary a. as follows:

- (a) the med. cord lies behind the 1st part of the artery then med. to its 2nd part. Its brs. lie med. to the 3rd part.
 (b) " lat. " " lateral to the 1st & 2nd parts of the artery & its branches lie lat. to the 3rd part of the artery.
 (c) " post. " lies lat. to the 1st part then post. to the 2nd part & " " " post. " " " " " " " " " " " "

- (4) **Axillary lymph nodes**: arranged in 5 groups in relation to the walls & apex of axilla (see p.132).

- (5) **Axillary tail of female breast** : an upward extension of the mammary gland into the axilla (p.133).

- (6) *n.to serratus ant.*: descends vertically on the med.-wall of the axilla in the midaxillary line.

- (7) Intercostobrachial n. : is the lat. cut. br. of T₂ nerve which crosses the axilla to supply its floor.

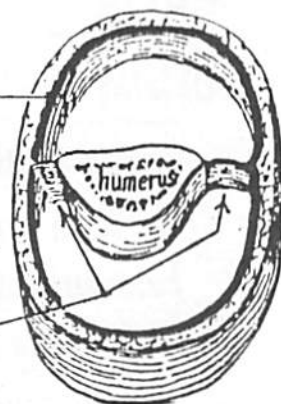
THE ARM

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DEEP FASCIA OF ARM (*brachial fascia*):

* Characters: it is thin in front & medially but thick behind & laterally.

* Extensions: it sends 2 fibrous membranes called the med. & lat. inter-muscular septa which extend deeply among the muscles of the arm to be attached to the medial & lateral borders of the humerus.



	Med. intermuscular septum	lat. intermuscular septum
Extension	shorter & broader, extending from med. epicondyle below to the insertion of coraco brachialis above.	longer & narrower, extending from the lat. epicondyle below to the lower part of lat. lip of the bicipital groove above.
Strength	it is stronger & thicker.	weaker & thinner.
Relations	it separates the brachialis anteriorly from med. head of triceps posteriorly.	it separates brachialis, brachioradialis & ext. carpi radialis longus anteriorly from the med. head of triceps posteriorly.
Structures piercing it	ulnar n. & sup. ulnar collateral vessels pierce it from before backwards at the level of insertion of coraco brachialis.	radial n. & ant. descending br. of profunda pierce it from behind forwards a little below the insertion of deltoid m.
Muscles arising from it	brachialis (anteriorly) & med head of triceps (posteriorly).	brachialis, brachioradialis & ext. carpi radialis longus (anteriorly) & med. head of triceps posteriorly.

MUSCLES OF ARM

* The 2 intermuscular septa together with the humerus, divide the arm into 2 compartments (ant. & post.):

(a) the ant. compartment (in front of the humerus & the 2 septa): Contains 3 muscles:

(1) biceps brachii m.: extends along the whole length of the arm.

(2) coraco-brachialis m.: lies in the upper $\frac{1}{2}$ of the ant. compartment.

(3) brachialis m.: lies in the lower $\frac{1}{2}$ " " " "

(b) the post. compartment (behind the humerus & the 2 septa) contains one m.: Triceps.

1. BICEPS BRACHII MUSCLE

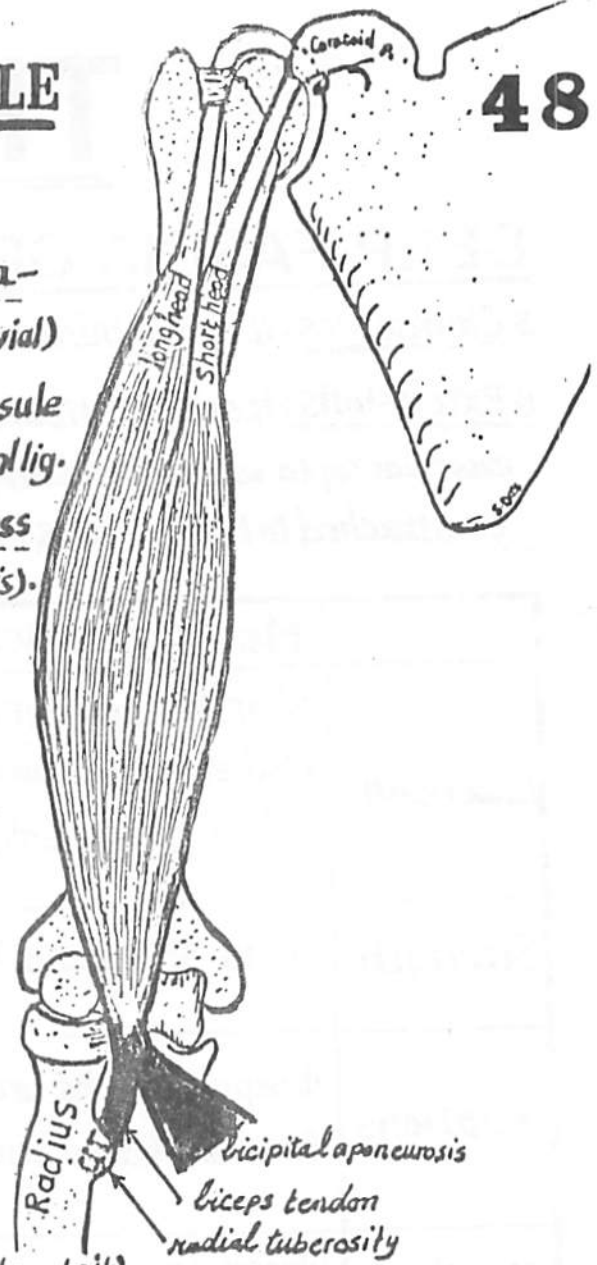
48

* Origin: by 2 heads: long & short:

- (1) long head: arises by a long tendon from the supra-glenoid tubercle of scapula (intracapsular & extrasynovial)
The tendon leaves the shoulder joint by piercing the capsule between the 2 tuberosities beneath the transverse humeral lig.
- (2) short head: arises from the tip of coracoid process of scapula (by a common tendon to it & coracobrachialis).

* Insertion: double:

- (1) biceps tendon: short strong tendon inserted into the post-rough part of the radial tuberosity.
N.B (a) the tendon is separated from the ant-smooth part of the tuberosity by a bursa.
(b) the tendon may contain a sesamoid bone.
- (2) bicipital aponeurosis: arises from the med. side of the biceps tendon & is inserted into the deep fascia of med. side of upper part of forearm.
N.B: the aponeurosis separates the median cubital v. (superficial to it) from the brachial a. & median n. (deep to it).



* N. Supply: from musculocutaneous n. (each head is supplied separately):

* Action: (1) powerful flexor & supinator of the forearm.

- (2) helps flexion of the arm
- (3) the long head steadies the head of the humerus in the glenoid cavity during abduction of the shoulder joint.
- (4) the bicipital aponeurosis stretches the deep fascia of the forearm & protects the underlying structures (brachial a. & median n.).

* Important relations:

(1) long head of origin	(2) the muscle belly	3-biceps tendon	4-bicipital aponeurosis
-its upper part: lies inside the shoulder joint (intracapsular & extrasynovial) & is surrounded by synovial sheath. -its lower part: runs in the bicipital groove under cover of the insertion of pectoralis major & in front of the tendon of insertion of latissimus dorsi.	-<u>deep to it</u>: the musculocutaneous n. descends between it & the brachialis m. -<u>medially</u>, the median nerve & the brachial artery. -<u>laterally</u>: the cephalic v. ascends along its lat. border.	-<u>medially</u>: median n. & brachial a. -<u>laterally</u>: radial n.	-<u>superficially</u>: the median cubital -<u>deeply</u>: the brachial artery & median nerve.

* Origin: from the tip of coracoid process (by a tendon common to it & the short head of biceps) & descends along the med. side of biceps m.

* Insertion: into the middle of the medial border of humerus.

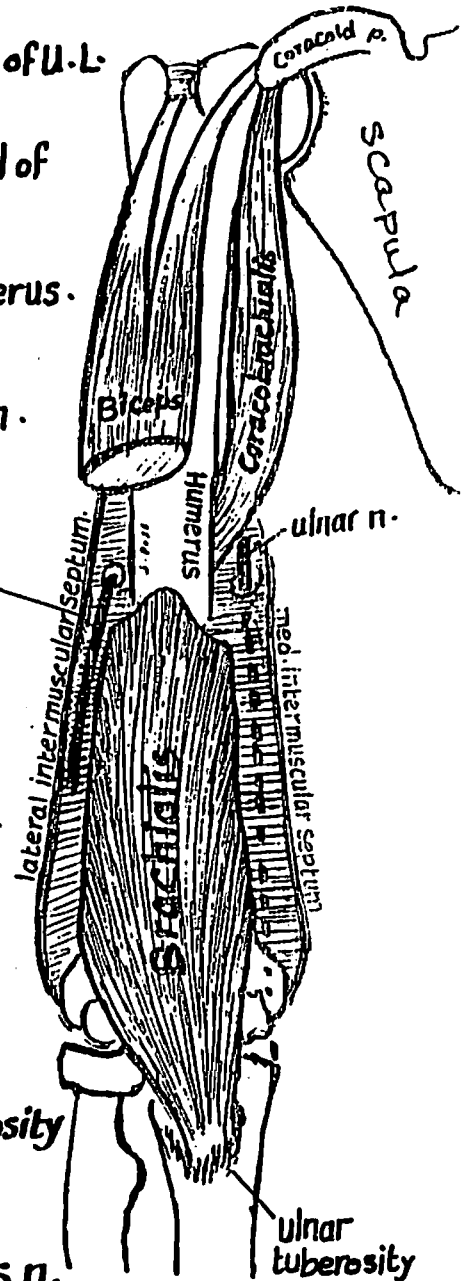
* N. Supply: br. from the musculo-cutaneous n. (before it pierces the muscle).

* Action: it is a weak flexor & adductor of the arm.

N.B: the coracobrachialis represents the adductor muscle mass of U.L.

* Relations: the following anatomical events occur at the level of insertion of coracobrachialis:

- (1) the insertion of deltoid m. on the anterolateral surface of humerus.
- (2) ulnar n. (with the sup. ulnar collateral a.) pierces the medial intermuscular septum to reach the post. compartment of arm.
- (3) median n. crosses the brachial a. from lat. to medial.
- (4) radial n. pierces the lat. intermuscular septum.
- (5) med. cut. n. of forearm pierces the deep fascia
- (6) basilic v. pierces the deep fascia.
- (7) the nutrient a. of humerus enters the nutrient foramen.



3. BRACHIALIS MUSCLE

* Origin: (1) From the lower $\frac{1}{2}$ of the front of the humerus.
(2) » med. & lat. intermuscular septa of the arm.

* Insertion: by a short thick tendon into the ulnar tuberosity (on the ant. surface of coronoid process of ulna).

* N. Supply: (1) its med. part is supplied by musculocutaneous n.
(2) its lat. part is supplied by the radial n. (this part is considered as a part of triceps m. which has migrated forwards & fused with the brachialis m. but retaining its nerve supply from the radial n.).

* Action: it is the main flexor of the elbow joint.

* Important relations:

- (1) anteriorly: musculo cutaneous n. & biceps muscle.
- (2) medially: median n. & brachial artery.
- (3) laterally: the radial n. & descending br. of profunda artery.

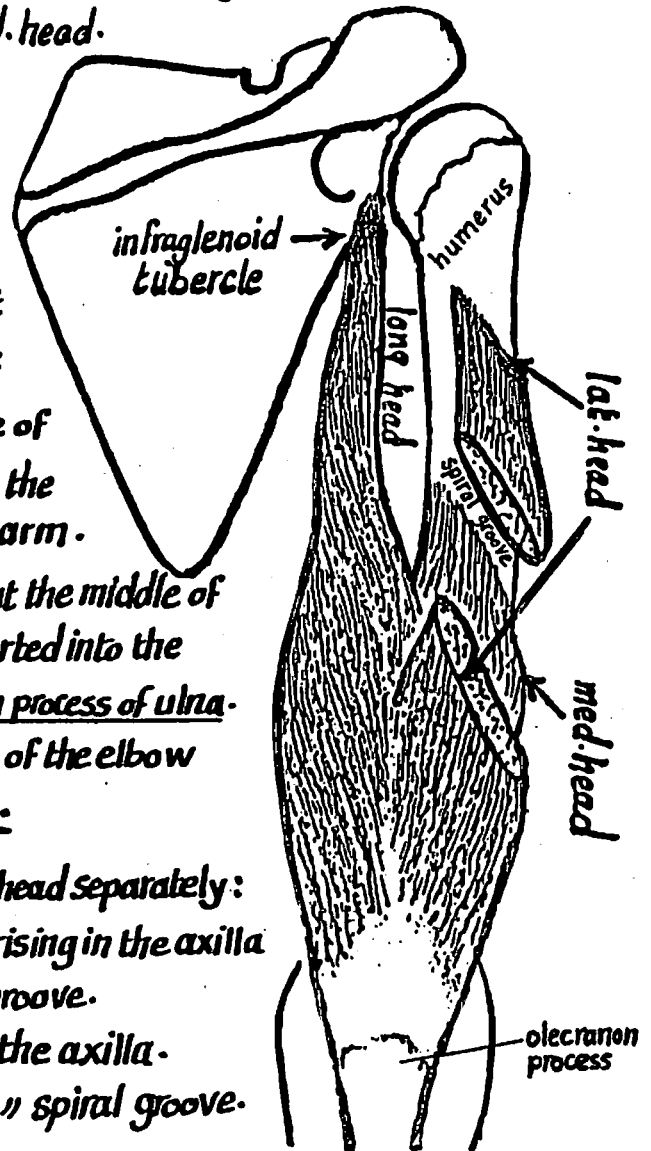
4. TRICEPS MUSCLE

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- * it is the muscle occupying the post. Compartment of the arm.
- * it is formed of 3 heads : long, lat. & medial.
- * the superficial part of the muscle is formed by the long & lat. heads while the deep part is formed by the med. head.

* Origin: by 3 heads:

- (1) long head: From the infraglenoid tubercle of scapula.
- (2) lat. head: From oblique ridge on the post surface of humerus above the spiral groove
- (3) med. head: From the whole post. surface of humerus below the spiral groove + from the med. & lat. intermuscular septa of the arm.



* Insertion: the 3 heads unite together about the middle of the arm forming a common tendon which is inserted into the post. part of the upper surface of the olecranon process of ulna.

N.B.: few deep fibres are inserted into the Capsule of the elbow joint forming the articularis cubiti m.

* Nerve Supply: radial n.; supplying each head separately:

- (1) the med. head: supplied by 2 branches : one arising in the axilla & the other arising in the spiral groove.
- (2) the long head: by one branch arising in the axilla.
- (3) the lat. head: " " " " " " spiral groove.

* Action:

- (1) the muscle as a whole is the main extensor of the elbow joint.
- (2) the long head is a weak extensor of the shoulder. It also supports the inf. aspect of the capsule of the shoulder joint when the arm is abducted above the head.
- (3) the articularis cubiti m. pulls up the capsule of the elbow joint during its extension.

THE FOREARM

DEEP FASCIA OF FOREARM (antebrachial fascia)

* It has the following characters:

- (1) it is well developed posteriorly than anteriorly & more thickened distally than proximally.
- (2) it is particularly thickened in front & behind the wrist forming flexor & extensor retinacula.
- (3) it gives partial origin to the superficial muscles of the front & back of the forearm.
- (4) it is thickened along the post. border of the ulna forming the ulnar aponeurosis which gives origin to 3 muscles : (1) flexor carpi ulnaris (2) extensor carpi ulnaris (3) flexor digitorum profundus.

MUSCLES OF FOREARM

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(A) THE SUPERFICIAL GROUP OF THE MUSCLES OF THE FRONT OF FOREARM

* They include 5 muscles arranged as follows

(from lat. to medial) :

- (1) pronator teres.
- (2) flexor carpi radialis.
- (3) palmaris longus (may be absent).
- (4) flexor digitorum superficialis (lies in deeper plane)
- (5) Flexor Carpi ulnaris

* General rules about these muscles :

(1) Origin :

- all of them arise from the front of med. epicondyle.
- some of them have additional origin from other bones.

(2) Insertion :

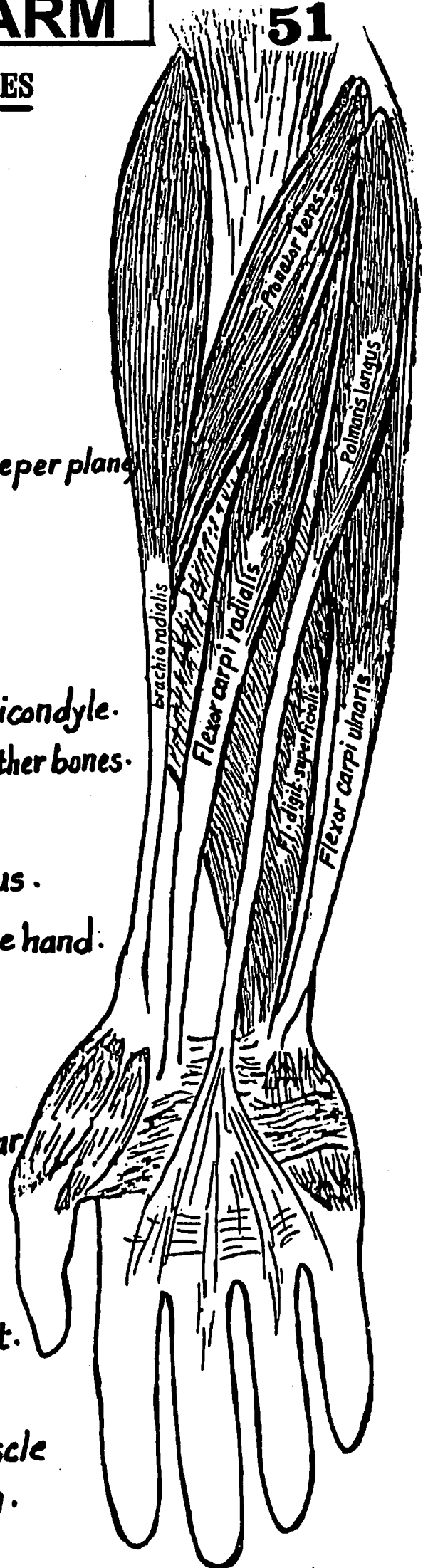
- The pronator teres is inserted in the radius.
- the remaining 4 muscles are inserted in the hand.

(3) N. supply :

- all of them are supplied by the median n.
- Except Flexor Carpi ulnaris (supplied by ulnar nerve).

(4) Action :

- all of them help in flexion of elbow joint.
- each muscle has a specific action which is indicated by the name of the muscle
e.g : pronator teres : involved in pronation.



1. PRONATOR TERES MUSCLE

* Origin: by 2 heads:

- (1) humeral head: from the lower part of the med. supra-condylar ridge + the front of med-epicondyle (Common Flexor origin).
- (2) ulnar head: from the med. border of coronoid process of ulna.

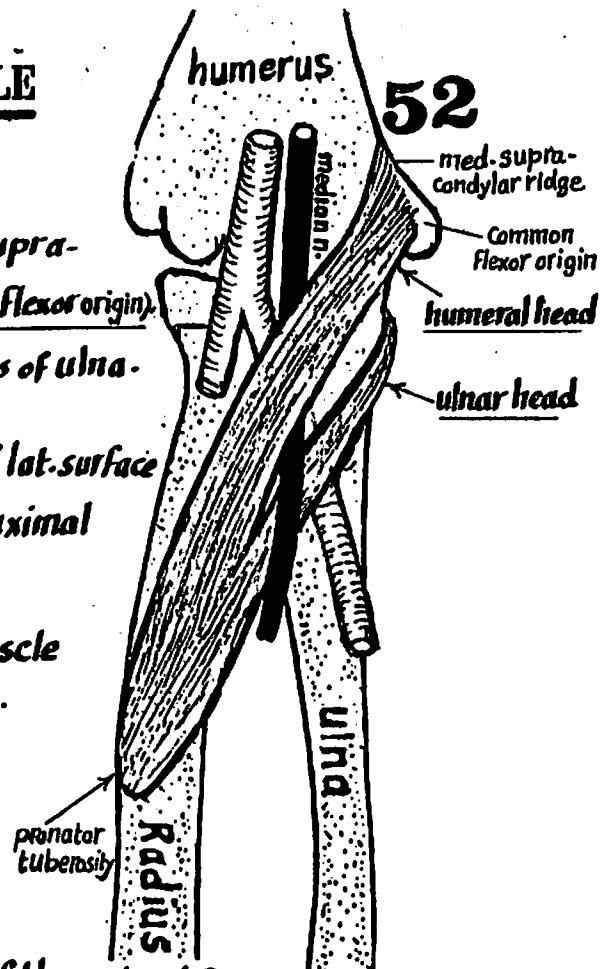
* Insertion: into pronator tuberosity on the middle of lat. surface of radius at the most curved part of the bone (to give maximal range of pronation).

* N. Supply: median n. (it gives a branch to the muscle in the cubital fossa before piercing it).

* Action: (1) pronation of the forearm. (2) helps flexion of the forearm.

* Relations:

- (1) its lat. border forms the med. boundary of the cubital fossa.
- (2) the median n. passes between the 2 heads of the muscle.
- (3) ulnar a. passes deep to the ulnar head of the muscle which separates it from the median n.



2. FLEXOR CARPI RADIALIS MUSCLE

* Origin: from the front of med. epicondyle of humerus (Common Flexor origin).

* Insertion: into palmar aspect of the bases of the 2nd & 3rd metacarpal bones.

* N. Supply: median n. (in the cubital fossa).

* Action: (1) helps flexion of the elbow. (2) Flexion of wrist. (3) Abduction (radial deviation) of wrist.

* Relations:

- (1) the muscle develops a strong tendon which descends vertically in the forearm.
- (2) at the wrist, the tendon pierces the flexor retinaculum & occupies the groove on the front of trapezium having a special synovial sheath.
- (3) the tendon is an important landmark at the wrist: the radial a. lies lat. to it while median n. lies medial to it.



3. PALMARIS LONGUS

53

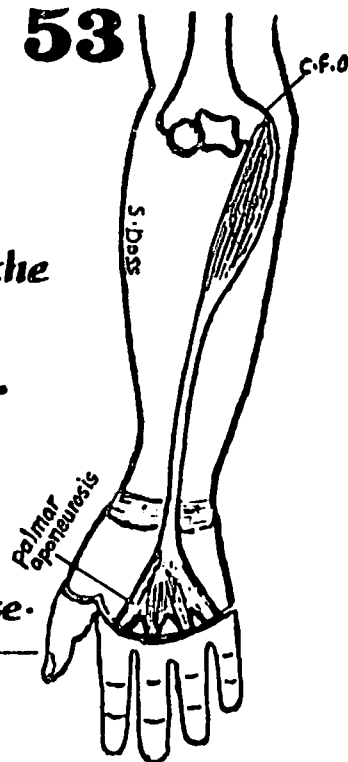
* it is a small m. with a long tendon which may be present or absent.

* Origin: From the Common flexor origin.

* Insertion: (1) the superficial part of the tendon is inserted into the apex of the palmar aponeurosis of the palm.
(2) the deep part of the tendon blends with the ant. surface of the Flexor retinaculum of the wrist.

* N. Supply: median n. (by a br. arising in the cubital fossa).

* Action: (1) a weak flexor of the elbow & wrist joints.
(2) protects the palm by putting the palmar aponeurosis tense.



4. FLEXOR DIGITORUM SUPERFICIALIS

* Origin: by 2 heads:

- (1) humero-ulnar head arising from: (a) Common flexor origin
(b) med. border of Coronoid process of ulna + ulnar collateral lig.
- (2) Radial head: from the ant. oblique line of radius.

* Course & Insertion:

- (1) the muscle develops 4 tendons about the middle of the forearm.
(the tendons for the ring & middle fingers are superficial to those of the index & little fingers).
- (2) the tendons pass through the Carpal tunnel to enter the palm then diverge to enter the fibrous flexor sheaths of the med. 4 fingers.
- (3) on the palmar surface of the proximal phalanx, each tendon is divided by the tendon of Flexor digit. profundus into 2 slips which are inserted into the sides of the front of the shaft of the middle phalanx.

* N. Supply: Median n. (by a branch arising in the cubital fossa).

* Action: (1) flexes the middle & proximal phalanges.
(2) flexes the wrist joint & helps flexion of the elbow.

* Important relations:

(A) in the forearm:

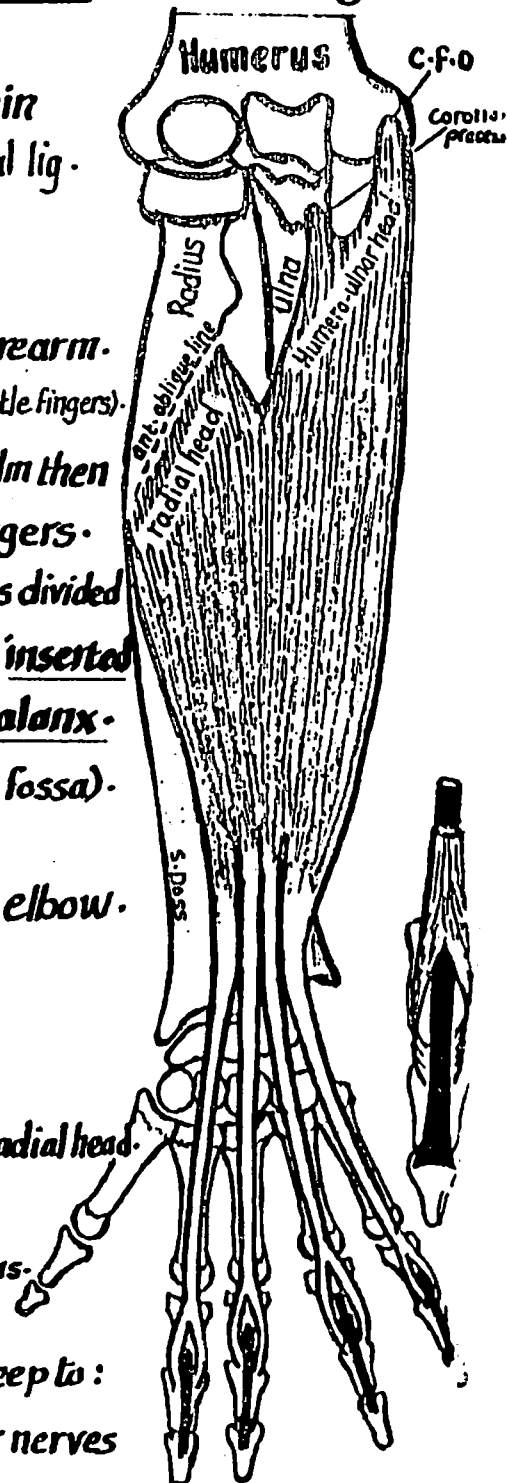
- (1) the median n. is adherent to its deep surface.
- (2) radial a. & superficial radial n. descend superficial to its radial head.

(B) In the Carpal tunnel:

- (1) its tendons lie superficial to the tendons of Fl. digit. profundus.
- (2) the median n. lies lat. to its tendons.

(C) In the hand: its tendons run in the mid palmar space deep to:

- (1) palmar aponeurosis
- (2) digital branches of median & ulnar nerves
- (3) the superficial palmar arch & its branches.



5. FLEXOR CARPI ULNARIS

origin : by 2 heads

- (1) humeral head : arises from the common flexor origin.
- (2) ulnar head : from the med. border of the olecranon process & upper 2/3 of post. border of ulna (through the ulnar aponeurosis).

Insertion : into pisiform bone. The insertion is then continued distally to:

- (1) the base of the 5th metacarpal bone (through the pisometacarpal lig.).
- (2) the hamate bone (through the pisohamate lig.).

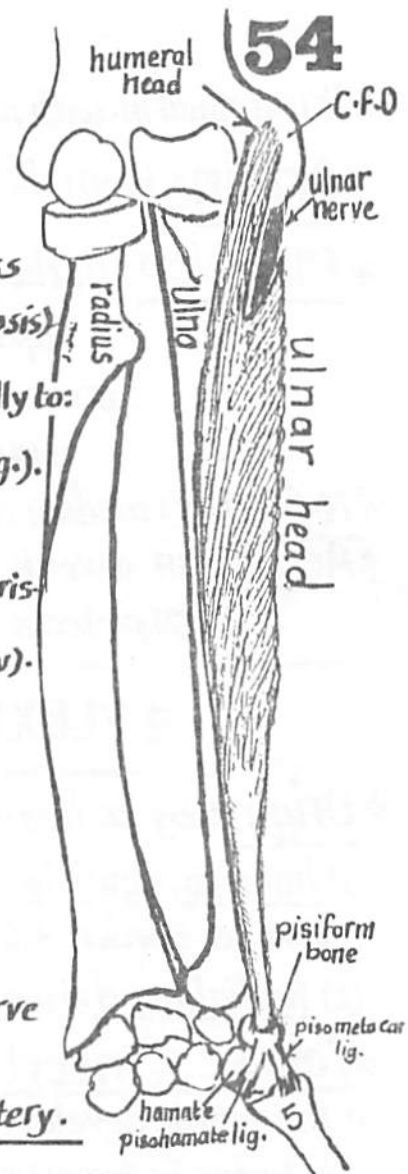
NB : the pisiform is a sesamoid bone inside the tendon of Flexor carpi ulnaris.

N. supply : ulnar n. (by a br. arising short distance below the elbow).

Action : (1) helps flexion of the elbow.
(2) flexes & adducts the wrist joint.

Important relations :

- (1) at its origin : the ulnar n. passes between its 2 heads of origin.
- (2) along its course : it overlies Flexor digiti profundus with the ulnar nerve & artery in between.
- (3) at its insertion : its tendon lies just med. to the ulnar nerve & ulnar artery.



THE DEEP GROUP OF MUSCLES OF THE FRONT OF THE FOREARM

1. FLEXOR POLLICIS LONGUS MUSCLE

- * **Origin** : (1) upper 2/3 of ant. surface of radius (below the ant. oblique line).
(2) the adjoining part of the interosseous membrane.

N.B : it is a unipennate muscle.

* **Insertion** : into the palmar aspect of the base of terminal phalanx of thumb.

* **N. Supply** : ant. interosseous n. (a branch of the median nerve).

- * **Action** : (1) flexes all the joints of the thumb.
(2) helps flexion of the wrist joint.

* **Important relations** :

- (1) in the forearm : it lies under cover of the radial head of Flex. digiti. superficialis & is related medially to the ant. interosseous nerve & artery.
- (2) just above the wrist : its tendon lies directly deep to the tendon of Flexor carpi radialis.
- (3) its tendon enters the hand through the lat. part of the carpal tunnel.
- (4) in the hand, its tendon lies between opponens pollicis & adductor pollicis.



2. FLEXOR DIGITORUM PROFUNDUS

55

- * Origin: (1) upper $\frac{3}{4}$ of ant. & med. surfaces of ulna & med. side of the coronoid process.
(2) the adjoining part of the interosseous membrane.
(3) the upper $\frac{3}{4}$ of the post. border of ulna through the ulnar aponeurosis.

* Course & insertion: the muscle gives rise to 4 tendons which pass to the medial 4 fingers as follows:

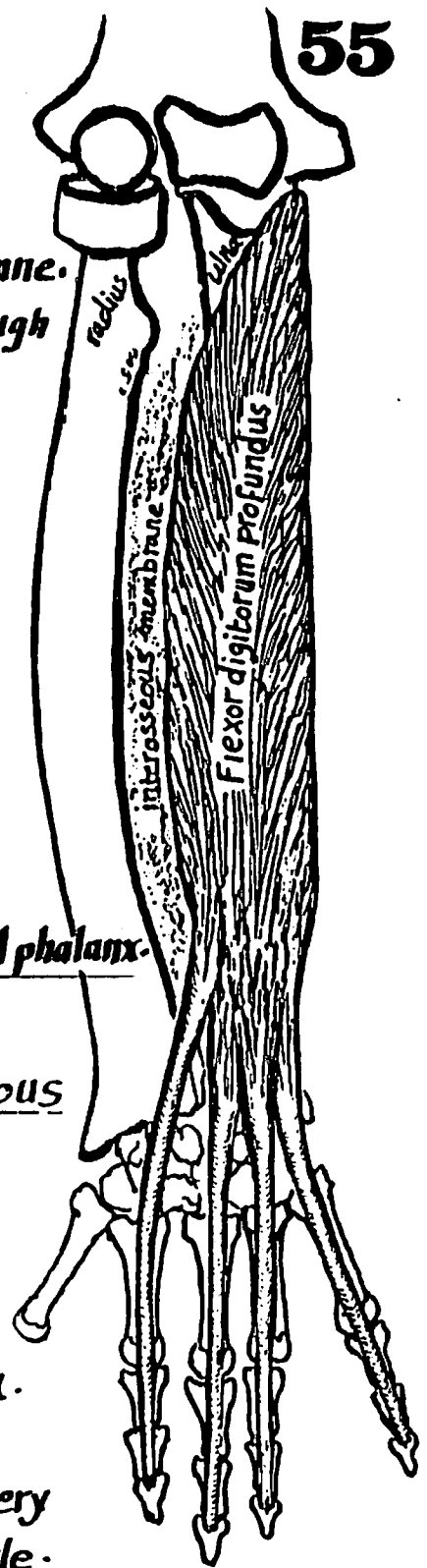
- (1) the 4 tendons reach the hand by passing through the carpal tunnel deep to the tendons of the flexor digitorum superficialis.
- (2) in the hand, the 4 tendons give rise to 4 lumbrical muscles then enter the fibrous flexor sheaths of the med. 4 fingers.
- (3) opposite the proximal phalanx, each tendon passes through the splitted tendon of the flexor digitorum superficialis to reach its insertion in the palmar surface of the base of the terminal phalanx.

- * N. Supply: (1) its medial part: supplied by ulnar n.
(2) its lat. part: supplied by the ant. interosseous nerve (branch of median n.).

- * Action: (1) flexion of all joints of the med. 4 fingers.
(2) flexion of the wrist joint.

* Important relations:

- (1) the superficial surface is related to the ulnar n. & ulnar a. which descend between it & the flexor carpi ulnaris m.
- (2) its lat. border is related to the ant. interosseous nerve & artery which descend between it & the flexor pollicis longus muscle.



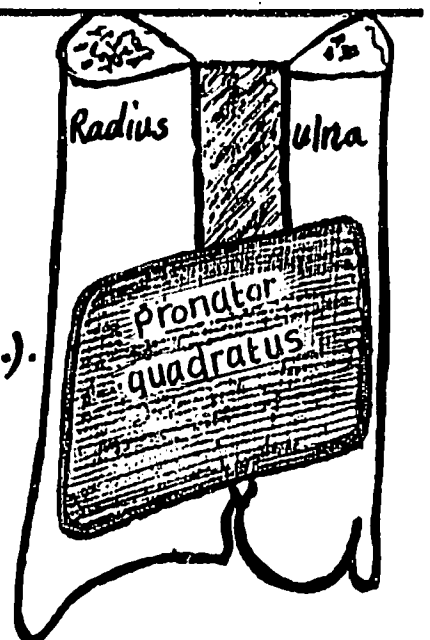
3. PRONATOR QUADRATUS MUSCLE

* Origin: lower $\frac{1}{4}$ of ant. surface of ulna.

* Insertion: into lower $\frac{1}{4}$ of ant. surface of radius.

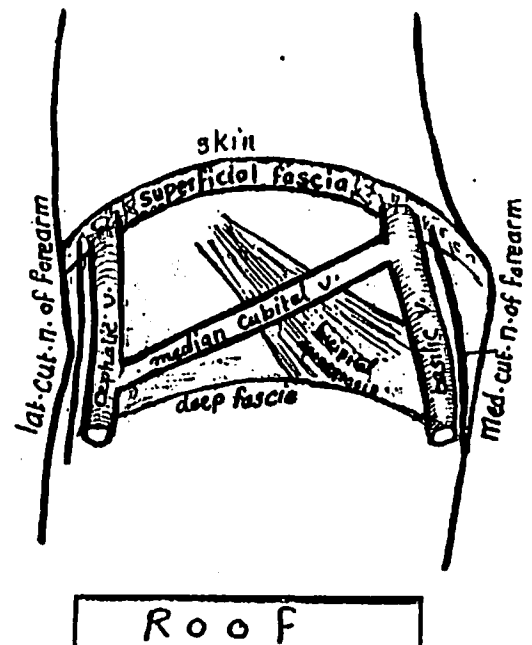
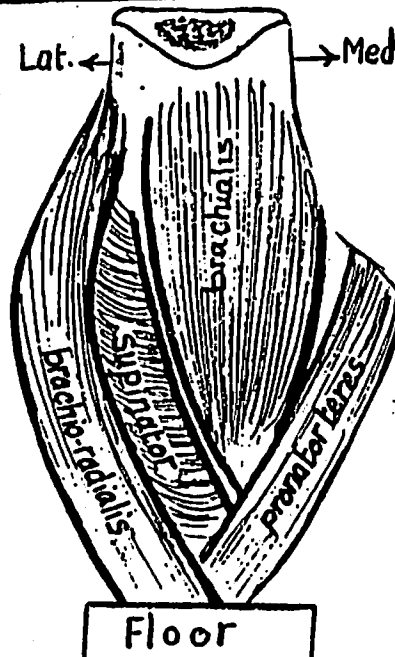
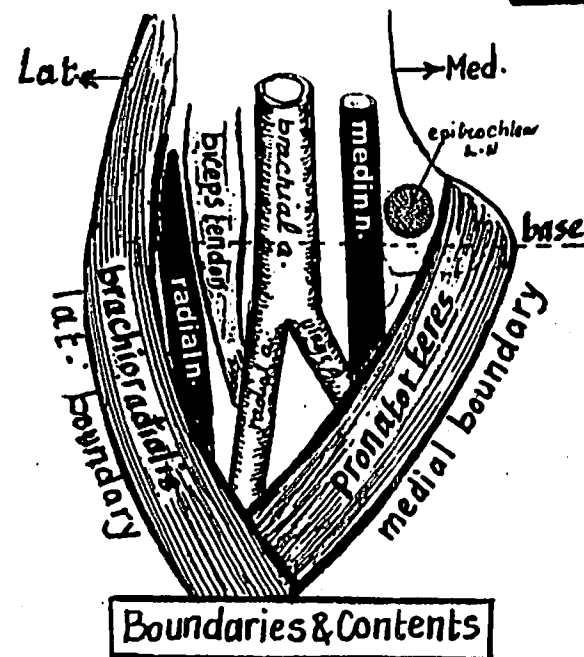
* N. Supply: ant. interosseous n. (br. from median n.).

- * Action: (1) Pronation (prime mover).
(2) fixation of the distal ends of radius & ulna in pronation & supination.



CUBITAL FOSSA

56



* **Site**: it is an intermuscular space in front of elbow.

* **Shape**: triangular in shape its base above & apex below.

* **Boundaries**: (1) base: an imaginary line between the 2 humeral epicondyles.

(2) med. border: pronator teres m.

(3) lat. border: brachio-radialis m.

(4) apex: is formed by the meeting of the med. & lat. borders
(brachioradialis overlapping pronator teres).

* **Floor**: formed by (1) brachialis (above & medially) (2) supinator (below & laterally).

* **Roof**: formed by:

- (1) skin (2) superficial fascia containing: (a) basilic v. with ant. br. of med. cut. n. of forearm (medially) (b) cephalic v. with ant. br. of lat. cut. n. of forearm (laterally). (c) median cubital v. connecting the basilic & cephalic veins.
- (3) deep fascia (reinforced by the bicipital aponeurosis).

* **Contents**: (arranged from med. to lateral as follows):

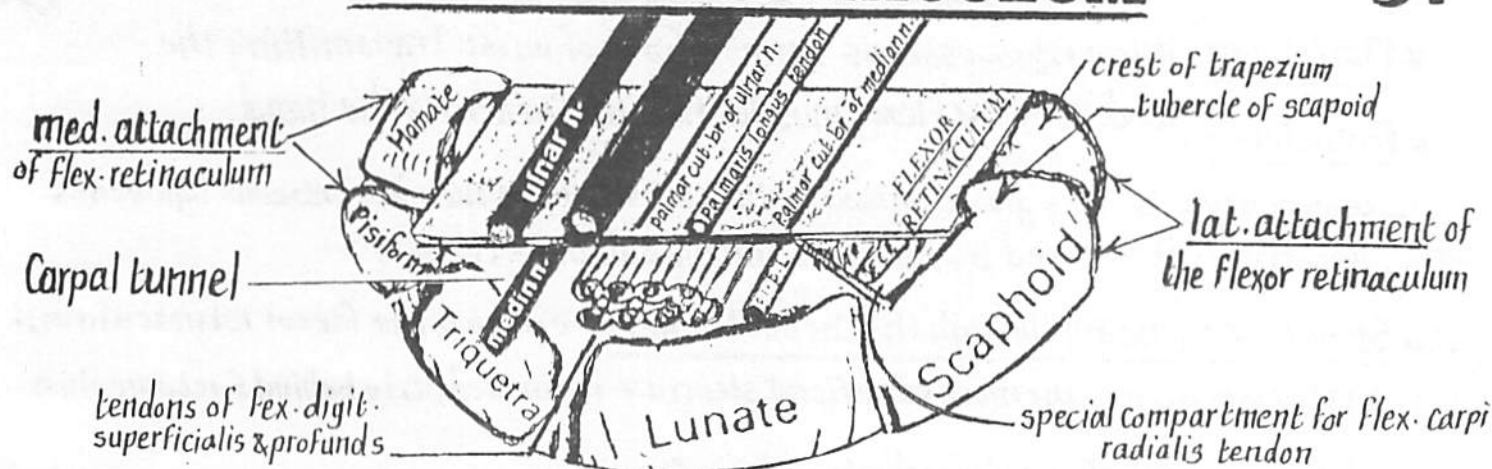
- (1) Median n.: leaves the fossa by passing between the 2 heads of pronator teres.
- (2) the terminal part of brachial a. & the beginning of both radial & ulnar arteries:
(a) the radial a. leaves the fossa by passing deep to its apex.
(b) " ulnar a. " " " " " " " pronator teres m.

(3) Biceps tendon: passes backwards to reach its insertion in the radial tuberosity.

(4) Radial n. & its post. Interosseous br.:

- the radial n. leaves the fossa by passing deep to the brachioradialis m.
- the post-interosseous n. leaves the fossa by piercing the supinator m.

N.B: the cubital fossa contains one L.N. (epitrochlear L.N.) lying in front of the med. epicondyle.



*** Definition:** it is a strong band of deep fascia that stretches across the ant. surface of the Carpal bones converting the concavity of the Carpus into a tunnel for the passage of the flexor tendons from the forearm to the hand.

*** Attachments:**

- medially: it is attached to: (1) pisiform (2) hook of hamate

- Laterally: it splits into 2 laminae:

(a) superficial lamina: attached to the tubercle of scaphoid & crest of trapezium

(b) deep lamina: attached to the med. lip of the groove on the trapezium

N.B: between the 2 laminae lies the tendon of Flexor Carpi radialis (in a special compartment outside the carpal tunnel).

- above: it is continuous with the deep fascia of the fore arm.

- below: its lower border is continuous with the palmar aponeurosis.

*** Function:** it acts as a strap, binding down the flexor tendons preventing them from springing away from the bone during flexion of the wrist joint.

*** Structures passing superficial to the flexor retinaculum:** (from med. to lateral):

(1) ulnar n. (just lat. to pisiform bone).

(2) ulnar a. (just lat. to ulnar n.)

(3) palmar cutaneous br. of ulnar n.

(4) palmaris longus tendon.

(5) palmar cutaneous br. of median n.

*** Muscles attached to the flexor retinaculum:**

(1) Origin of the 3 thenar muscles (abd., flexor & opponens): from its lat. part.

(2) origin of the 3 hypothenar m. (, , &) : from its med. part.

(3) origin of the palmaris brevis

(4) insertion of the deep fibres of the tendon of palmaris longus m.

* Definition: it is a fibro-osseous canal in front of wrist transmitting the

* Boundaries: tendons of the flexor muscles from the forearm to the hand

- posteriorly: the bony groove formed by the carpal bones & their interosseous ligaments.
- anteriorly: it is closed by the flexor retinaculum of the wrist.

* Structures passing through the Carpal tunnel (i.e deep to the flexor retinaculum):

(1) Median n.: it is the most superficial structure i.e immediately behind F-retinaculum.

(2) the 4 tendons of the flexor digitorum superficialis } enclosed by their common flexor

(3) " " " " flexor digitorum profundus } synovial sheath (ulnar bursa).

(4) the tendon of flexor pollicis longus within its own synovial sheath (radial bursa).

(5) the recurrent br. of deep palmar arch ascending in front of carpal bones to join the ant-carpal anastomosis.

N.B: the tendon of flexor carpi radialis occupies a special compartment in front of trapezium deep to the lat. end of the flexor retinaculum (not a content of C-tunnel).

* Clinical importance: **CARPAL TUNNEL SYNDROME**:

* definition: it is a condition in which there is a compression of the median n. as it passes through the carpal tunnel leading to its injury.

* Causes: (1) dislocation of one of the carpal bones inside the carpal tunnel.

(2) thickening of the tendons passing (as in tenosynovitis & acromegaly).

(3) myxoedema or tumour inside the carpal tunnel pressing on the median n.

* Effects: (see median n. injury).

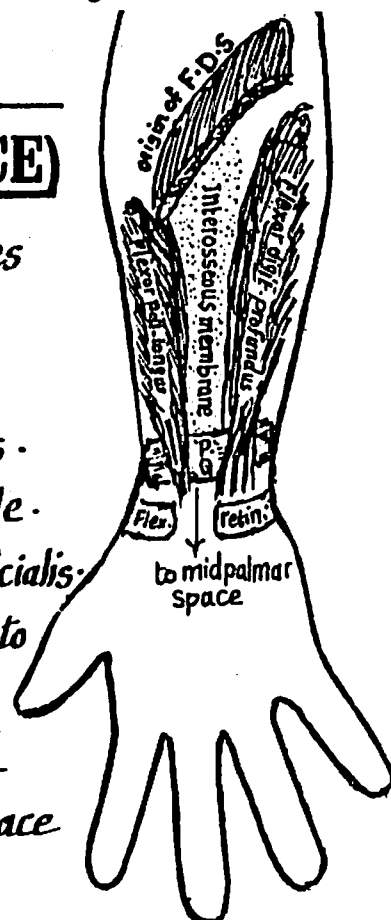
THE SPACE OF PARONA (RETROFLEXOR SPACE)

* Definition: it is a fascial space deep to the flexor muscles of the front of forearm.

* Boundaries:

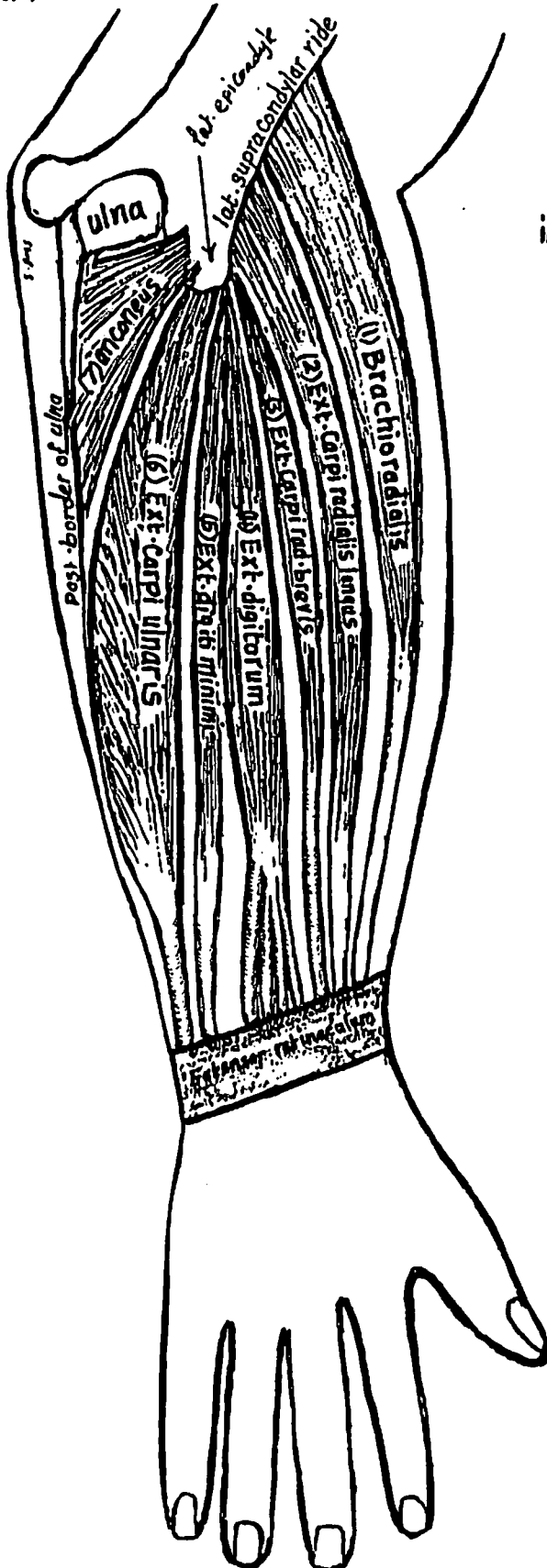
- anteriorly: flexor digitorum superficialis & profundus muscles.
- posteriorly: interosseous membrane & pronator quadratus muscle.
- above: it is limited by the oblique line of origin of flexor digit. superficialis.
- below: it passes deep to the flexor tendons & flexor retinaculum to become continuous with the midpalmar space of the hand.

* Clinical importance: infection may extend from the midpalmar space of the hand to reach the forearm through the space of parona.



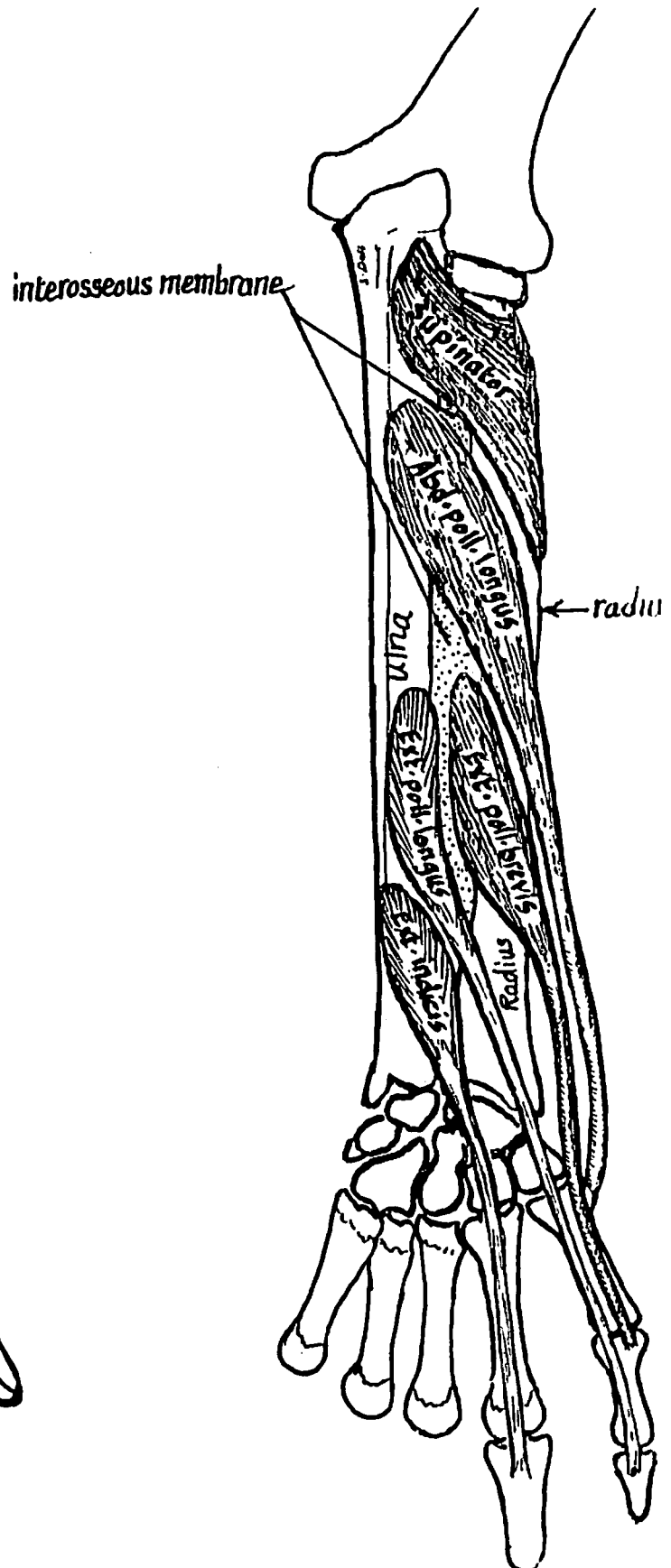
(A) SUPERFICIAL GROUP(7)

- (1) brachioradialis .
- (2) Ext-Carpi radialis longus .
- (3) " " " brevis .
- (4) Extensor digitorum .
- (5) " " digiti minimi .
- (6) " " Carpi ulnaris
- (7) Anconeus m .



(B) DEEP GROUP(5)

- (1) supinator m .
- (2) Abductor pollicis longus .
- (3) Ext-pollicis brevis .
- (4) Ext-pollicis longus .
- (5) Ext-indicis .



1. BRACHIORADIALIS MUSCLE

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Origin: (1) from the upper 2/3 of lat. supracondylar ridge of humerus.
(2) from the lat. intermuscular septum of the arm.

Insertion: into lat. surface of lower end of radius just above the styloid process.

N. supply: radial n. (by a br. arising on the lat. side of the arm).

Action: (1) initiates pronation & supination of the forearm.
(2) flexion of the forearm in the midprone position.
(it is the muscle of the military salute).

Important relations:

in the arm: it is separated from brachialis m. by the radial n.

At elbow: it forms the lat. boundary of the cubital fossa.

In the forearm: it overlies the radial a. & superficial radial nerve.

2. EXTENSOR CARPI RADIALIS LONGUS M.

Origin: (1) lower 1/3 of the lat. supracondylar ridge of the humerus.
(2) from the lat. intermuscular septum of the arm.

Insertion: into the back of the base of the 2nd metacarpal bone.

N. Supply: radial n. (by a br. arising on the lat. side of the arm).

Action: (1) extension of the wrist
(2) abduction (radial deviation) of the hand.

3. EXTENSOR CARPI RADIALIS BREVIS M.

* **Origin:** From the front of the lat. epicondyle of the humerus (common extensor origin).

* **Insertion:** into the back of the base of 3rd metacarpal bone.

* **N. Supply:** Post. Interosseous n. (the deep br. of radial n.)
supplying the muscle before it pierces the supinator m.

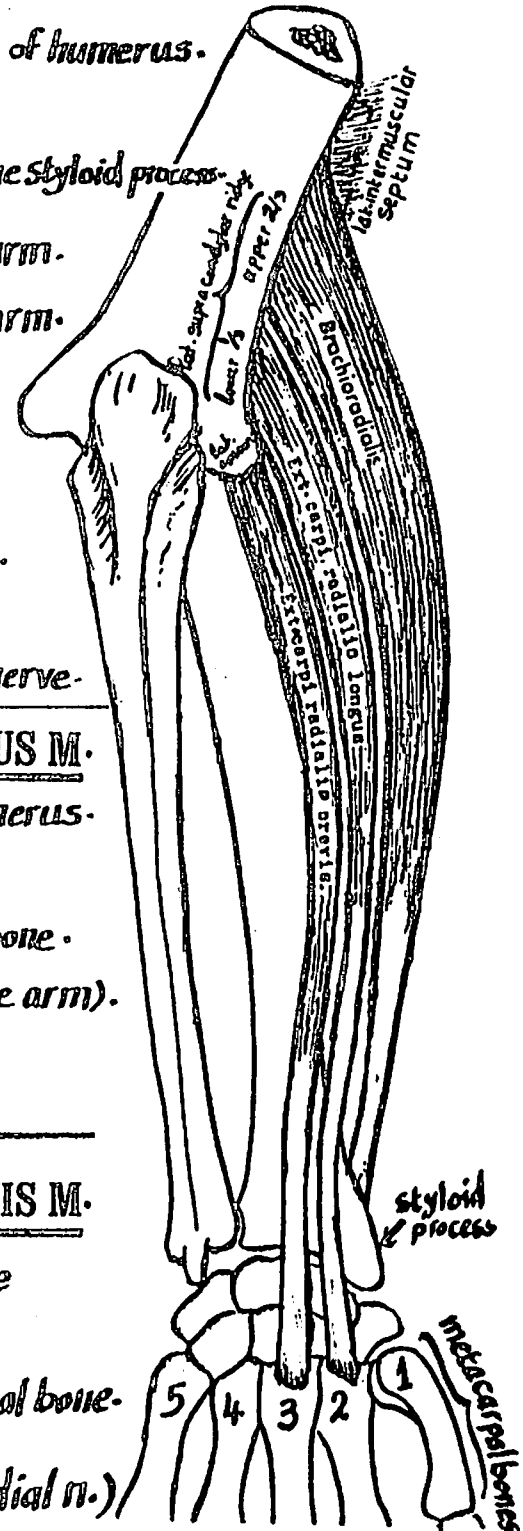
* **Action:** the same as extensor Carpi radialis longus.

4. EXTENSOR DIGITORUM MUSCLE

* **Origin:** from the common extensor origin (front of the lat. epicondyle).

* **Insertion:** into the bases of the middle & distal phalanges of the med. 4 fingers as follows:

- the muscle develops 4 tendons for the med. 4 fingers.
- the tendons pass deep to the extensor retinaculum to reach the dorsum of hand.



- the tendons spread on the back of the hand where they are connected connected together by "intertendinous connections"
 - on reaching the dorsum of the proximal phalanx, each tendon expands to form the "Extensor expansion"
 - the extensor expansion then divides into 3 slips :
 - middle slip : inserted into the base of the middle phalanx
 - 2 collateral slips : receive the insertion of lumbrical & interosseous muscles then become inserted into the base of the terminal phalanx.
- N.B : the extensor expansion of the index finger is joined by the ext. indicis tendon while that of the little finger is joined by the tendon of ext. digiti minimi.

* N. Supply : post. interosseous n.

* Action : (1) extension of the M.P. (metacarpo-phalangeal) & I.P. (interphalangeal) joints of the med. 4 fingers.
(2) extension of the wrist joint.

5. EXTENSOR DIGITI MINIMI MUSCLE

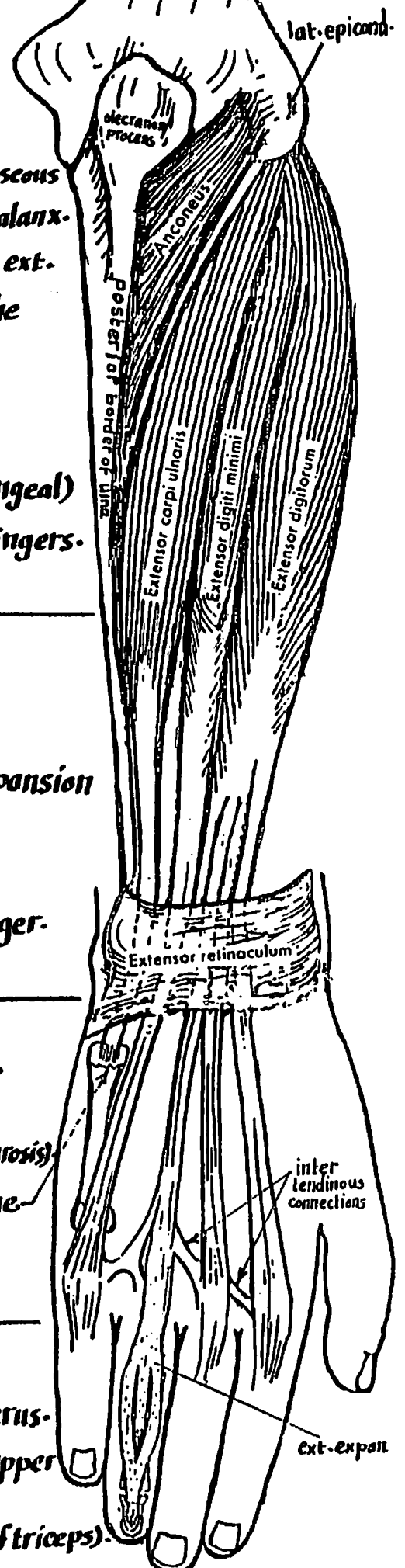
- * Origin : From the Common extensor origin.
- * Insertion : by a tendon which joins the extensor expansion of the little finger.
- * N. Supply : post. interosseous n.
- * Action : (1) extension of the joints of the little finger.
(2) " " " " wrist joint.

6. EXTENSOR CARPI ULNARIS MUSCLE

- * Origin : (1) Common extensor origin
(2) from the post. border of ulna (by the ulnar aponeurosis)
- * Insertion : into the back of the base of 5th metacarpal bone.
- * N. Supply : post. interosseous n.
- * Action : extension & adduction of the hand.

7. ANCONEUS MUSCLE

- * Origin : From the back of the lat-epicondyle of the humerus.
- * Insertion : into the lat. surface of olecranon process & the upper $\frac{1}{4}$ of post. border of ulna.
- * N. Supply : radial n. (by a br. passing through med. head of triceps).
- * Action : helps the extension of the elbow joint.



* Origin:

- (1) superficial fibres: arise from lat. epicondyle, radial collateral & annular ligaments.
- (2) deep fibres: arise from the supinator fossa & crest of ulna.

* Insertion: into upper $\frac{1}{3}$ of lat. surface of radius (between ant & post-oblique lines).

* N. Supply: post-interosseous n. which supplies it in the cubital fossa then pierces it & curves backwards around neck of radius between the superficial & deep fibres to reach the back of forearm.

* Action: (1) supination of forearm (in the extended position).
(2) fixation of radius to ulna (by the deep fibres).

9. ABDUCTOR POLLICIS LONGUS M

* Origin: (1) upper $\frac{1}{3}$ of post. surface of ulna.
(2) middle $\frac{1}{3}$ of post. surface of radius.
(3) back of the interosseous membrane.

* Insertion: lat. side of the base of the 1st metacarpal bone.

* N. Supply: post-interosseous n.

* Action: (1) abducts the thumb
(2) Can extend the thumb
(3) it can flex the wrist (only when other flexors are paralysed).

* Relations: (1) its tendon crosses superficial to the radial a. & the tendons of ext. carpi radialis longus & brevis mm.
(2) its tendon is closely related to that of Ext. pol. brevis & they together form the lat. boundary of the anatomical snuff-box.

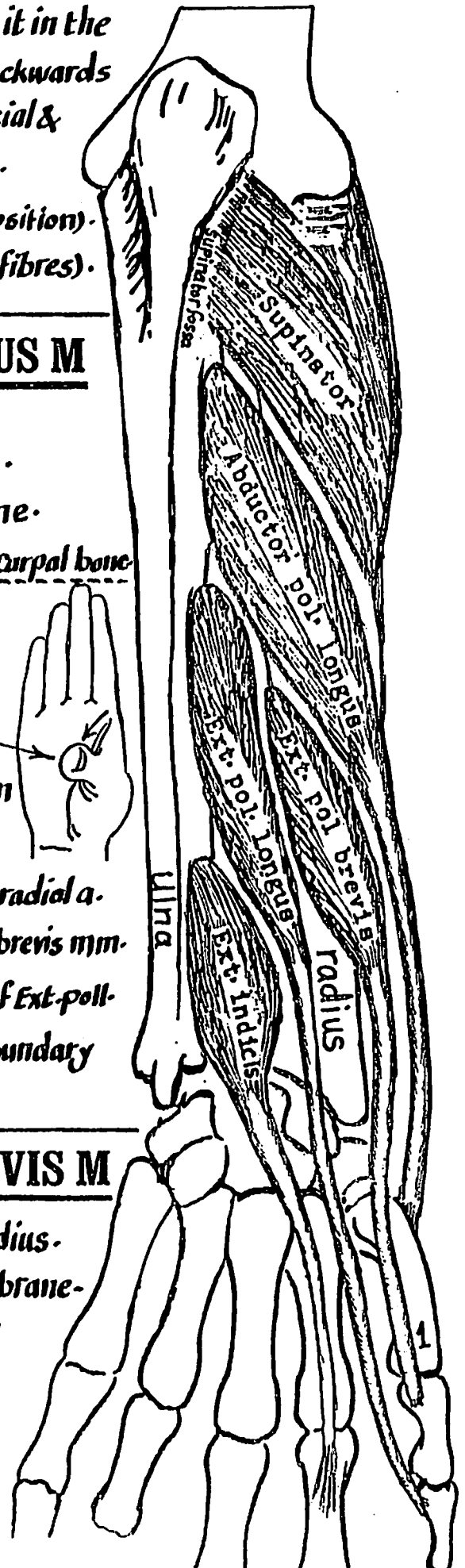
10. EXTENSOR POLLICIS BREVIS M

* Origin: (1) the distal $\frac{1}{3}$ of post. surface of radius.
(2) From back of the interosseous membrane.

* Insertion: into dorsum of the base of proximal phalanx of the thumb.

* N. Supply: post-interosseous n.

* Action: extension of the proximal phalanx of the thumb.



11. EXTENSOR POLLICIS LONGUS M

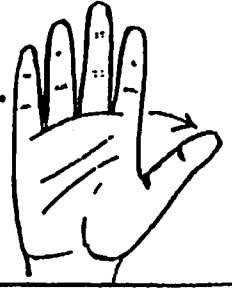
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* Origin: middle $\frac{1}{3}$ of the post. surface of ulna + the adjoining part of the interosseous membrane.

* Insertion: dorsum of base of the terminal phalanx of the thumb.

* N. Supply: post. interosseous n.

* Action: extension of all joints of the thumb



12. EXTENSOR INDICIS MUSCLE

* Origin: (1) lower part of post. surface of ulna (2) interosseous membrane.

* Insertion: joins the extensor expansion of the index finger.

* N. Supply: post. interosseous n.

* Action: extends the proximal phalanx of index finger

ANATOMICAL SNUFF BOX

* Definition:

it is a small depression on the posterolateral aspect of the wrist. It becomes more evident when the thumb is extended.

* Boundaries:

- anterolaterally: the tendons of
 ↗ abd. pollicis longus.
 ↘ ext. pollicis brevis.
- posteromedially: the tendon of extensor pollicis longus.

* Roof: formed by:

- (1) skin -
- (2) superficial fascia containing: (a) the beginning of cephalic v. (b) digital branches of superficial radial n.
- (3) deep fascia.

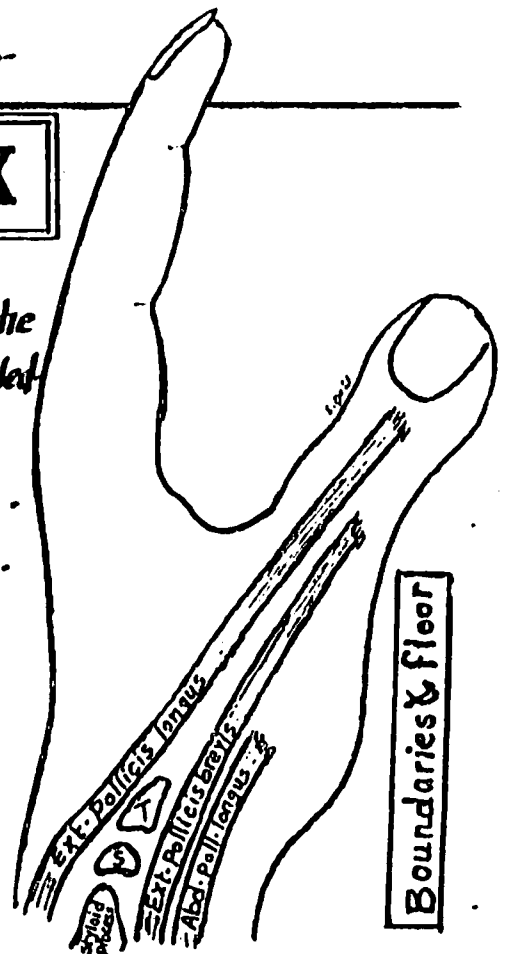
* Floor: formed by:

- (1) styloid process of radius.
- (2) scaphoid bone.
- (3) trapezium "

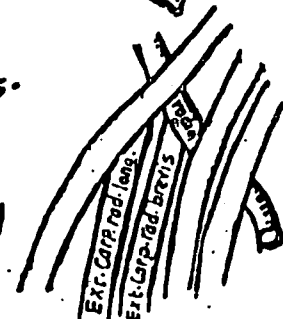
* Contents:

- (1) the tendons of ext. carpi radialis longus & brevis muscles.
- (2) radial a.

* Clinical importance: pain & swelling in the anatomical snuff-box occurs in fracture of the scaphoid bone.



Roof



Contents

EXTENSOR RETINACULUM

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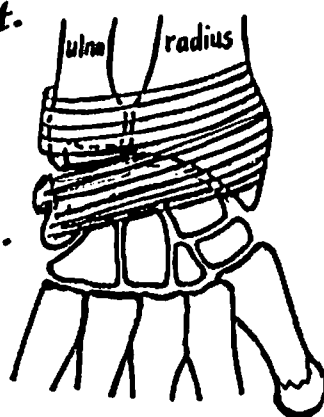
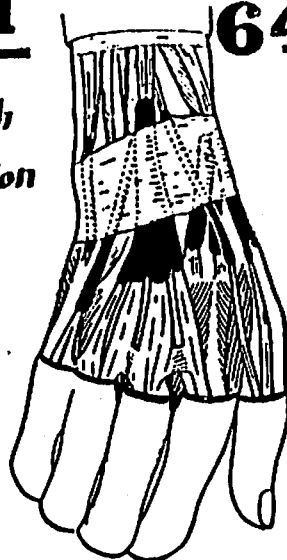
* Defintion : it is a thickened band of deep fascia about one inch wide. It lies obliquely across the extensor tendons at the junction of the back of fore arm & the hand.

N.B: it is longer, thinner & higher than the Flexor retinaculum.

* Function : it retains the extensor tendons in position preventing their springing away from the bones

* Attachments :

- laterally : it is attached to the sharp crest between the ant. & lat-surfaces of the lower end of radius.
- medially : it is attached to styloid process of ulna, triquetral & pisiform bones.
- above : it is continuous with deep fascia of the back of forearm.
- below : " " " " " " " " " " hand.

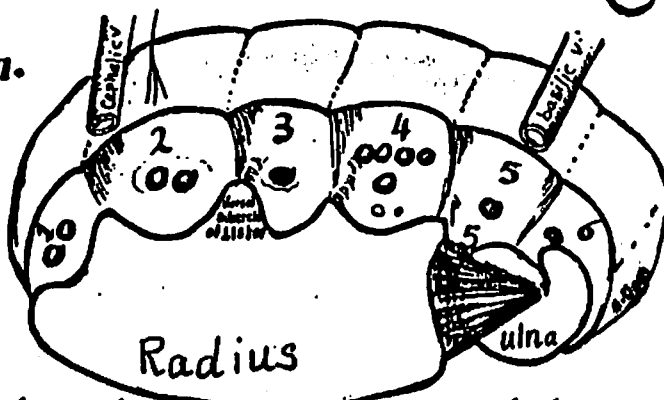


* Structures passing superficial to it

- (1) terminal branches of superficial radial n.
- (2) the beginning of the basilic v.
- (3) " " " " cephalic v.

* Structures passing deep to it :

- 5 fibrous septa descend from the deep surface of the retinaculum to the head of ulna & the ridges on the back of the lower end of radius dividing the tunnel deep to the retinaculum into 6 Compartments :



Compartment	Site	Structures passing
(1) First Com.	on the lat-side of styloid process of radius.	2 tendons : < abductor pollicis longus. extensor pollicis brevis.
(2) Second Com.	the most-lat-groove on the back of radius lat-to the dorsal tubercle	2 tendons < ext-Carpi radialis longus. ext-Carpi radialis brevis.
(3) Third "	a narrow groove just med. to the dorsal tubercle of radius	1 tendon : the ext-pollicis longus tendon.
(4) Fourth "	the most med-groove on the back of radius	4 Structures : (1) tendons of the ext-digitorum (2) ext-Indicis tendon (3) ant-Interosseous a. (4) post-interosseous n.
(5) Fifth "	between the distal ends of radius & ulna	1 tendon : ext-digiti minimi tendon.
(6) Sixth "	groove on the back of distal end of ulna	1 tendon : ext-Carpi Ulnaris tendon.

* **FUNCTIONS** the human hand is designed for

- (1) grasping.
- (2) precise movements.
- (3) serving as tactile organ.

* **POSITIONS OF THE HAND**

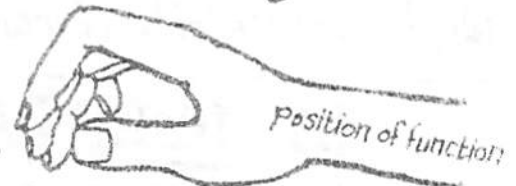
(1) Position of rest (relaxed hand position) in which:

- (a) the fingers are partially flexed: the flexion increases gradually from the index finger to the little finger.
- (b) the thumb is slightly opposed against the other fingers
- (c) the wrist is slightly extended



(2) Position of function: it is like the position of rest but with the following differences:

- (a) more flexion of the index finger
- (b) the thumb is rotated to oppose the index finger.
- (c) the wrist is more extended than in the resting position.

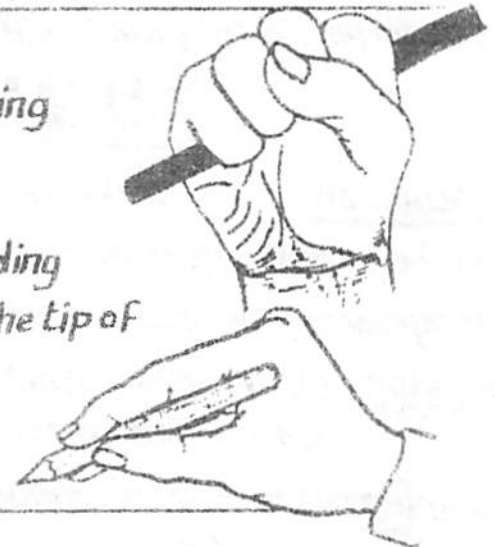


N.B: if surgical immobilization of the hand is required it is done in the position of function.

* **GRIPS OF THE HAND**

(1) Power grip: it is the position adopted by the hand in holding an object firmly between the fingers & the thumb.

(2) Precision grip: it is the position adopted by the hand in holding an object lightly & precisely between the tip of the thumb & the tip of the index with partial support by the middle finger e.g. holding a pencil in writing.



I- SKIN OF THE HAND

I- Skin of the dorsum: is thin, hairy & mobile.

II- Skin of the palm: is modified to increase the efficiency of the grip as follows:

- (1) it is thick (for protection of the underlying structures).
- (2) it is immobile because it is firmly fixed to the underlying subcutaneous tissue.
- (3) it is hairless & shows flexion creases & papillary ridges as follows:

(a) 2 transverse creases at the junction of the forearm with the hand:

- the proximal crease lies 1" proximal to the flexor retinaculum
- the distal crease corresponds to the proximal border of flexor retinaculum.

(b) 2 Vertical creases of the palm:

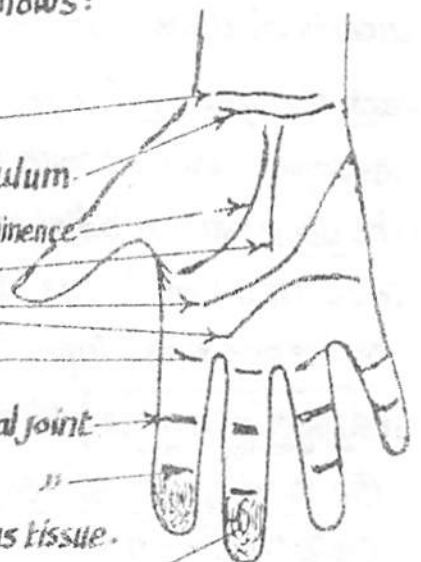
- (1) lat. crease at the root of the thenar eminence
- (2) med. " at the centre of the palm

(c) 2 transverse creases of the palm (proximal & distal)

(d) proximal digital crease: situated at the root of the finger

(e) middle digital crease: opposite the line of the proximal interphalangeal joint

(f) distal digital crease: just proximal to the line of the distal " " "



N.B: (1) at each crease, the skin is firmly fixed to the underlying subcutaneous tissue.

(2) the palmar surface of the fingers shows papillary ridges (finger prints)

II-SUPERFICIAL FASCIA OF THE PALM

- it is divided into small fat-filled loculi by dense fibrous strands which connect the skin to the underlying palmar aponeurosis.

- it contains the following structures

- (1) palmar cutaneous br. of ulnar n.
- (2) " " " " median n.
- (3) palmaris brevis muscle.

* Palmaris brevis muscle :

- origin : from the medial sides of flexor retinaculum & palmar aponeurosis.

- insertion : into the skin of the ulnar border of the hand.

- N. supply : superficial br. of ulnar n. - action : cupping of the hand.

III- DEEP FASCIA OF THE PALM

it is thin over the thenar & hypothenar eminences but thick in the central part of the palm & called palmar aponeurosis

PALMAR APONEUROSIS

* Definition : it is a thickened sheet of deep fascia in the central part of the palm. Phylogenetically, it represents the degenerated tendon of palmaris longus.

* Shape : it is triangular in outline having apex, base & 2 margins (med. & lat.).

(A) - its apex : is directed proximally (upwards) fusing with the flexor retinaculum & receiving the insertion of the palmaris longus tendon

(B) - its base is directed downwards & divides into 4 slips (for the med. 4 fingers) having the following features :

(1) they are connected together by transverse bands called superficial transverse metacarpal ligaments.

(2) each slip gives off 2 parts : superficial & deep

- the superficial part joins the overlying skin at the root of the finger.

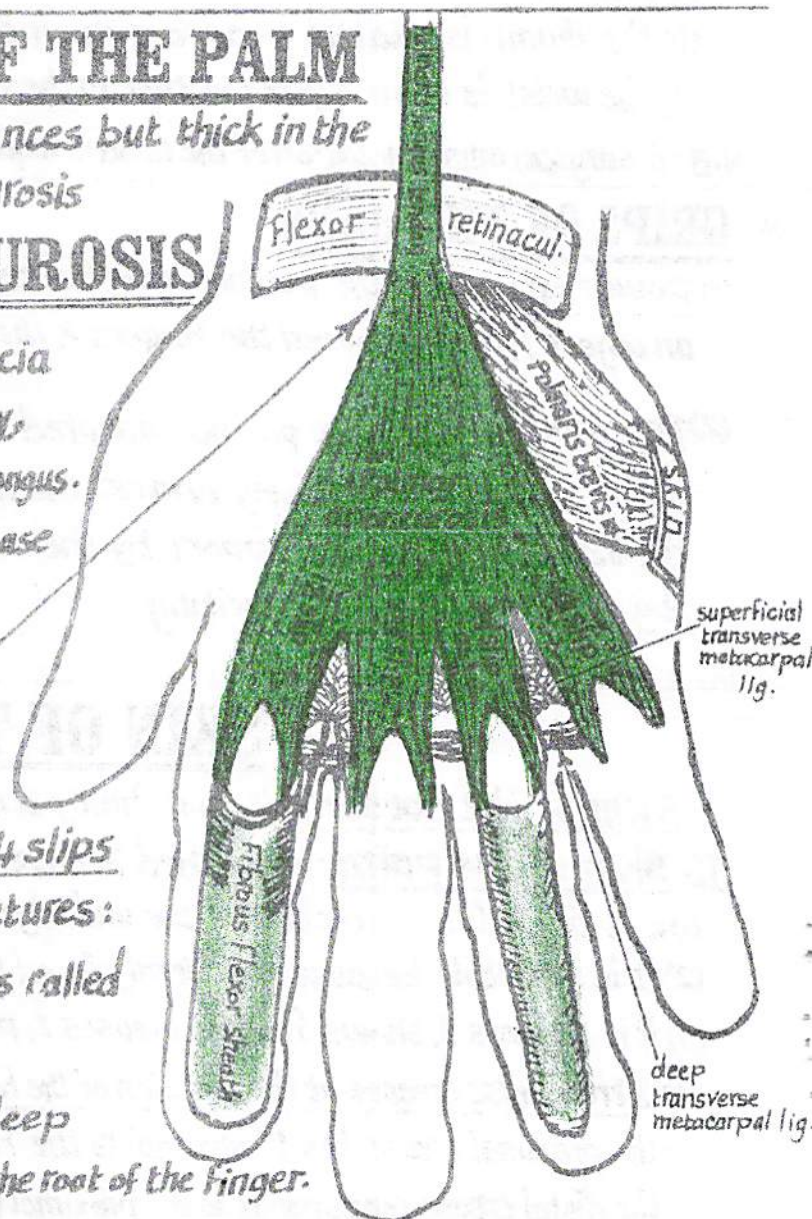
- the deep part subdivides into 2 bands which diverge from each other

to be attached to the fibrous flexor sheath & deep transverse metacarpal lig. of the corresponding finger. The space between each 2 slips contains

- 1 lumbrical muscle.
- 1 digital nerve.
- 1 " artery

(C) its medial margin : blends with the fascia covering the hypothenar muscles & gives off the medial palmar septum which passes deeply to get attached to the 5th metacarpal bone.

(d) its lateral border : blends with the fascia covering the thenar muscles & gives off



the lat. & intermediate palmar septa:

- the lat. palmar septum passes deeply to get attached to the 1st metacarpal bone.
- the intermediate palmar septum passes deeply to get attached to the 3rd metacarpal bone.

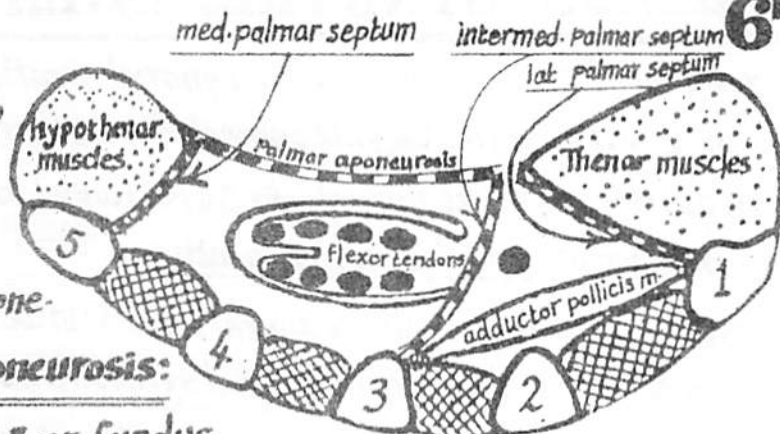
* Structures undercover of palmar aponeurosis:

- (1) tendons of flexor digitorum superficialis & profundus together with their synovial sheaths.
- (2) superficial palmar arch & its branches
- (3) terminal branches of the median & ulnar nn.

* Functions of the palmar aponeurosis:

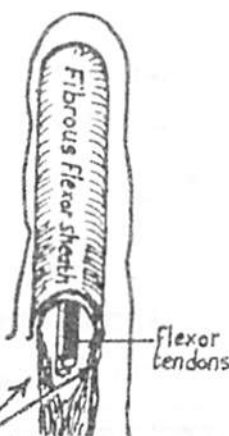
- (1) it fixes the skin of the palm and thus improves the grip.
- (2) it protects the underlying tendons, vessels & nerves.

* Clinical importance: Dupuytren's Contracture: is a pathological condition characterised by thickening & shortening of the palmar aponeurosis (commonly its med. side).



FIBROUS FLEXOR SHEATHS OF FINGERS

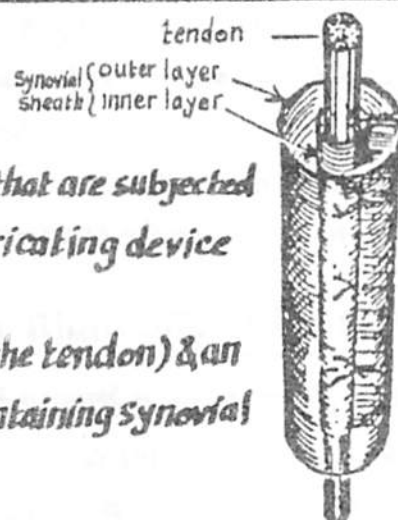
- * these are curved fibrous plates formed by thickening of the deep fascia on the palmar surfaces of the fingers
- * the edges of each sheath are attached to the margins of the phalanges & to the palmar ligaments of the M.P. & I.P. joints.
- * the distal end of each sheath is attached to the palmar surface of the distal phalanx just distal to the insertion of the flexor digitorum profundus tendon.
- * the proximal end of the sheath is continuous with the slips of palmar aponeurosis.
- * the fibrous flexor sheath is very dense opposite the phalanges but thin opposite the joints (so that it may not interfere with the flexion of the joints).
- * the sheath, together with the phalanges & palmar ligaments of the joints form an osteo-fibrous canal inside the finger that holds the flexor tendons in contact with the palmar surfaces of the phalanges during flexion of the fingers.



SYNOVIAL SHEATHS OF THE HAND

* Definition:

- the synovial sheath is a tubular bursa enveloping tendons that are subjected to friction on more than one side thus forming a sort of lubricating device for the tendon.
- the synovial sheath is formed of an inner tube (adherent to the tendon) & an outer tube separated from the inner one by a potential space containing synovial fluid for lubrication.



FLEXOR SYNOVIAL SHEATHS

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* the long flexor tendons acquire synovial sheaths at 2 sites (where they are subjected to friction):

(1) as they pass first through the Carpal tunnel, here they acquire carpal synovial sheaths.

(2) as they pass through the digital tunnels in the fingers, here they acquire digital synovial sheaths.

* Three synovial sheaths surround the flexor tendons at the wrist (and extend for about 1 inch above the flexor retinaculum) these 3 sheaths include:

(1) one sheath for the tendon of Flexor carpi radialis.

It extends distally as far as the insertion of the tendon.

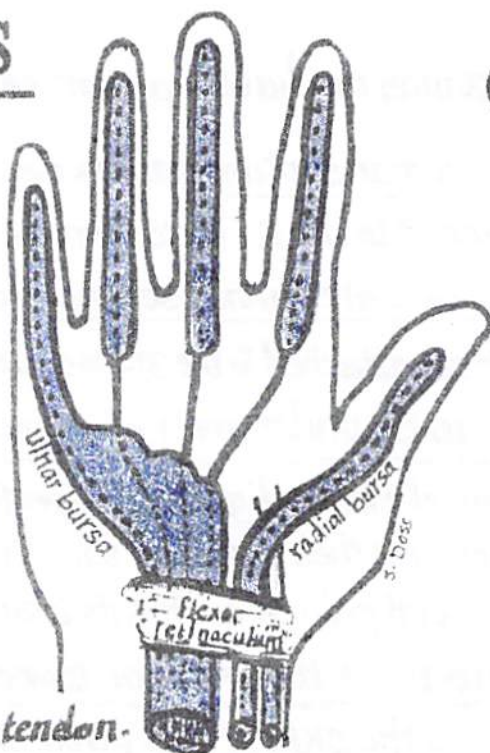
(2) one sheath for the tendon of Flexor pollicis longus which extends distally to become continuous with the digital synovial sheath of that tendon till its insertion.

This continuous synovial sheath around the Fl. pol. longus tendon is called Radial bursa

(3) the tendons of the flexor digitorum superficialis & profundus have a common synovial sheath that extends distally till the middle of the hand except the medial part of the common sheath which extends around the tendons of the little finger becoming continuous with the digital synovial sheath of the little finger & called Ulnar bursa

N.B: in 50% of cases the radial & ulnar bursae communicate together at the wrist.

* the tendons passing to the index, middle & ring fingers leave the common synovial sheath about the middle of the palm then acquire isolated digital synovial sheaths in the fingers.

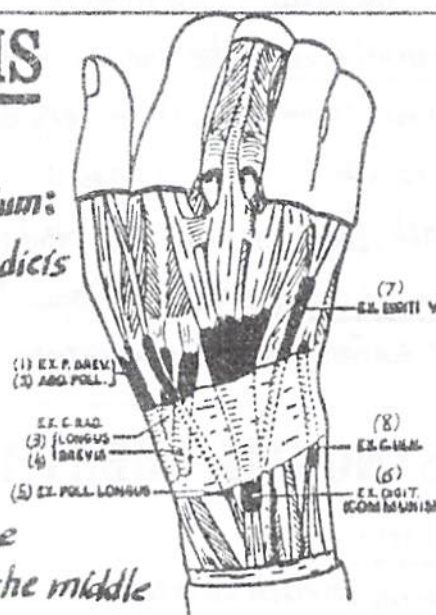


EXTENSOR SYNOVIAL SHEATHS

* There are 8 synovial sheaths at the back of wrist enveloping the tendons passing deep to the ext. retinaculum: one sheath for each tendon except the ext. digitorum & indicis which have one common synovial sheath.

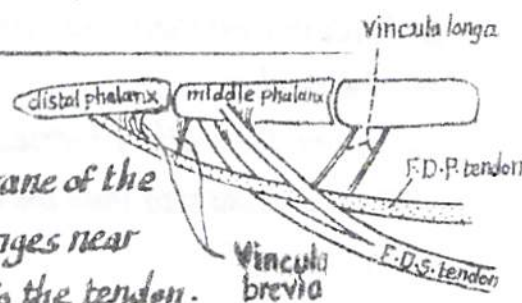
* Extent of the extensor synovial sheaths:

- the proximal ends of the s. sheaths lie deep to or slightly above the extensor retinaculum.
- the distal ends of the s. sheaths reach the ends of the tendons inserted in the metacarpal bones but end at the middle of the hand for the tendons inserted into the phalanges.



* Vincula tendinum (brevia & longa):

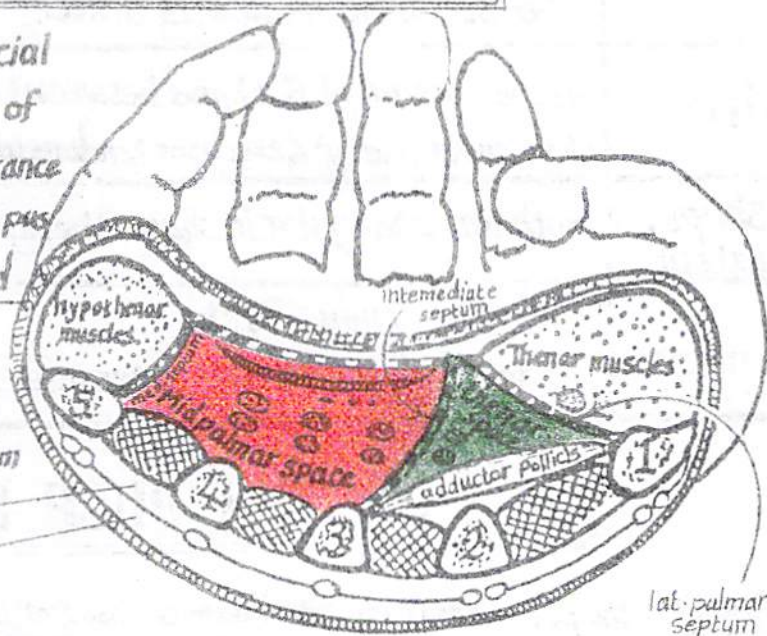
they are triangular thread like bands of the synovial membrane of the synovial sheath that connect the flexor tendons to the phalanges near the insertion of the tendons. They carry minute blood vessels to the tendon.



* The arrangement of the fascia & the fascial septa in the hand leads to the formation of many spaces which are of surgical importance as they may become infected & distended with pus.

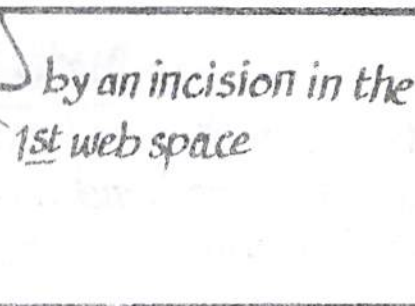
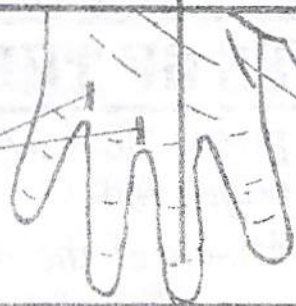
* The important fascial spaces of the hand include :

- (1) the midpalmar space
- (2) the thenar space
- (3) the dorsal subaponeurotic space
- (4) the dorsal subcutaneous space
- (5) the pulp space of the fingers



(1) & (2) THE MIDPALMAR & THENAR SPACES

Features	MidPalmar Space	Thenar Space
(1) outline :	triangular	triangular
(2) Site :	under the med. $\frac{1}{2}$ of the hollow of the palm.	under the lat. $\frac{1}{2}$ of the hollow of the palm.
(3) Boundaries:		
-ventrally :	palmar aponeurosis	palmar aponeurosis
-dorsally :	3rd, 4th & 5th metacarpal bones & the intervening interosseous mm.	the transverse head of adductor pollicis & the covering deep fascia.
-medially :	the medial palmar septum	the intermediate palmar septum.
-laterally :	the intermediate palmar septum	the lateral palmar septum.
(4) Extent:		
-proximally :	to the distal margin of flex. retinacul.	to distal margin of flexor retinaculum.
-distally :	to the distal transverse palmar crease.	to the proximal transverse palmar crease
(5) Communications		
-proximally :	with the space of Parona in the forearm.	
-distally :	with the webs between the med. 4 fingers	with the web between the thumb & the index finger.
(6) Contents:		
	(1) tendons of flex. digit. superficialis & profundus to the med. 3 fingers.	(1) long flexor tendons of the thumb & the index finger.
	(2) the med. 3 lumbrical muscles	(2) the 1st (lateral) lumbrical muscle.
	(3) digital nerves & vessels to the med. $3\frac{1}{2}$ fingers.	(3) digital nerves & vessels to the lat. $1\frac{1}{2}$ digits.
(7) Drainage of pus in the space	by an incision in the 3rd or 4th web space	by an incision in the 1st web space



	dorsal subcutaneous space	dorsal Subaponeurotic Space
site	on the dorsum of the hand between the skin (superficially) & extensor tendons (deeply)	between the extensor tendons (superficially) & the metacarpals & interosseous mm. (deeply)
shape & extent	both are triangular in shape, being coextensive with the dorsum of the hand.	
Contents:	(1) dorsal venous arch (2) dorsal digital nerves & vessels	

(5) THE PULP SPACE

* **Definition:** the pulp space is the subcutaneous tissue of the terminal phalanx of fingers (tips of fingers).

* It is closed proximally by the fusion of the deep fascia (at the distal skin crease) to the periosteum of the base of terminal phalanx just distal to the insertion of the flexor digitorum profundus tendon.

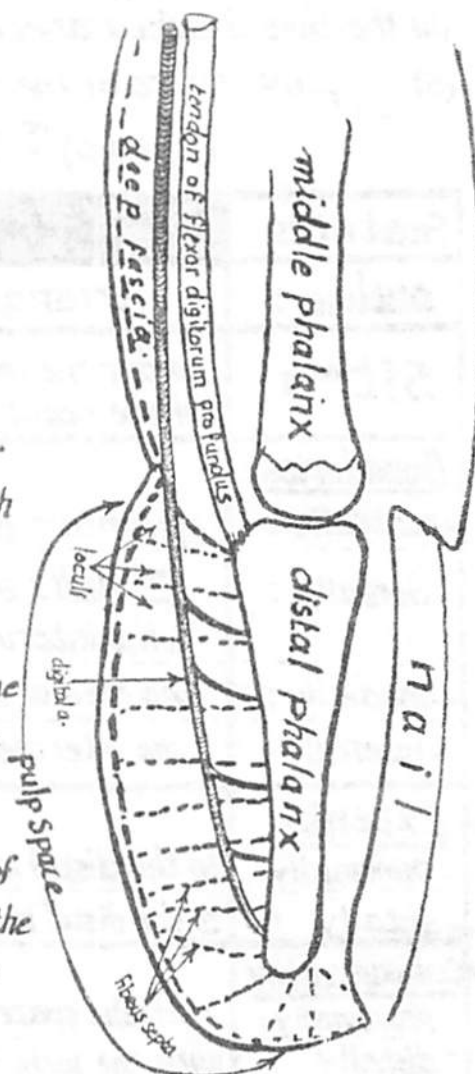
* the pulp space is divided, by many fibrous septa extending from skin to bone, into large number (about 16) of small loculi filled with subcutaneous fat.

* these loculi are traversed by the terminal branches of the digital artery which supply the shaft (but not the base) of the terminal phalanx.

* **Clinical importance:**

(1) pulp space infection is called whitlow. It produces severe throbbing pain due to rising tension in the closed space as the compact fat filling the loculi leaves very little space for the accumulation of the pus of the inflammation.

(2) severe infection of the pulp space may lead to thrombosis of the branches of the digital a. supplying the bone with consequent necrosis of the shaft of the terminal phalanx. The base of the phalanx is not affected as it receives a branch from the digital a. in the middle segment of the finger.



VESSELS OF THE HAND

(1) ulnar artery in the hand & the superficial palmar arch: see p. 83.

(2) radial " " " " & the deep palmar arch: see p. 85.

(3) venous drainage of the hand: see pages 88 & 89

NERVES OF THE HAND

(1) median n. in the hand: see pages 96 & 97.

(2) ulnar n. in the hand: see page 100.

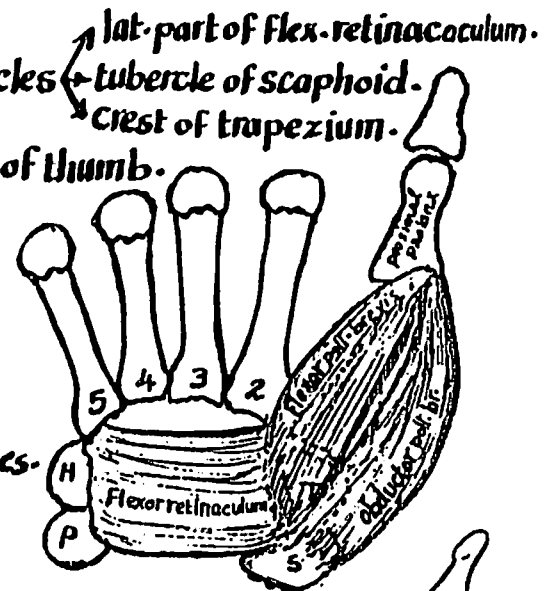
(3) superficial radial n. on the dorsum of the hand: see page 104

I-MUSCLES OF THE LATERAL COMPARTMENT (the 4 thenar muscles):

- * they lie in relation to the 1st metacarpal bone & form the thenar eminence.
- * 3 of them lie lat. to the tendon of flexor pollicis longus & supplied by the lat. division of median n. These 3 muscles include:
 - (1) abductor pollicis brevis : superficial & lat. in position
 - (2) Flexor pollicis brevis : superficial & med. to the abd. pollicis brevis.
 - (3) opponens pollicis : deep to both abductor & flexor pollicis brevis mm.
- * the 4th muscle is the adductor pollicis which lies med. to the tendon of flexor pollicis longus & is supplied by the deep br. of ulnar n.

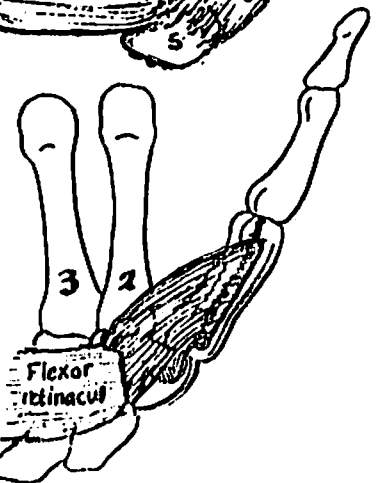
(1) Abductor pollicis brevis:

- * Origin : from the common origin of the thenar muscles
 - lat. part of flex. retinaculum.
 - tubercle of scaphoid.
 - crest of trapezium.
- * Insertion : into lat. side of base of proximal phalanx of thumb.
- * N. Supply : lat. division of median nerve
- * Action : abducts the thumb



(2) Flexor pollicis brevis:

- * Origin : from the common origin of thenar muscles.
- * Insertion : the same as Abductor pollicis brevis.
- * N. Supply : " " " " " " " "
- * Action : flexes the proximal phalanx of the thumb.



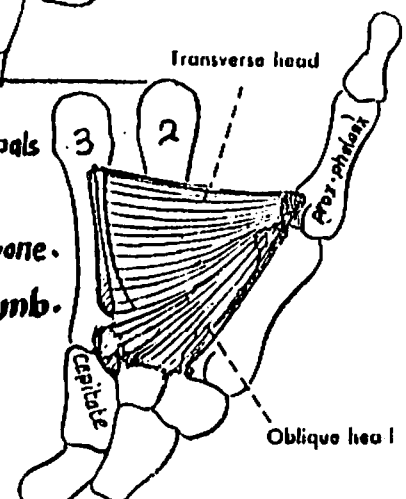
(3) Opponens pollicis:

- * Origin : from the common origin of the thenar muscles
- * Insertion : into the lat. 1/2 of the ant. surface of the 1st metacarpal bone.
- * N. supply : lat. division of median n.
- * Action : opposes the thumb against other fingers



(4) Adductor pollicis:

- * Origin : (1) oblique head arises from
 - bases of 2nd & 3rd metacarpals
 - Capitate bone
- (2) transverse n : " from the front of the 3rd metacarpal bone.
- * Insertion : into med. side of base of the proximal phalanx of thumb.
- * N. supply : deep br. of ulnar n.
- * Action : adducts the thumb.



I-- MUSCLES OF THE MEDIAL COMPARTMENT

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* they are 3 muscles forming the *hypothenar eminence* & arranged as follows

- (1) Abductor digiti minimi : superficial & med. in position.
- (2) Flexor digiti minimi brevis : superficial & lat. to the abd. digiti minimi.
- (3) opponens digiti minimi : deep to the previous 2 muscles

* they are all supplied by the deep branch of ulnar nerve.

(1) Abductor digiti minimi :

* Origin : From pisiform bone.

* Insertion : into the med. side of base of proximal phalanx of the little finger.

* N. supply : deep br. of ulnar n.

* Action : abducts the little finger.

(2) Flexor digiti minimi brevis :

* Origin : From hook of hamate & the med. part of the flexor retinaculum.

* Insertion : the same as the abd. digiti minimi.

* N. supply : deep br. of ulnar n.

* Action : flexion of the proximal phalanx of the little finger.

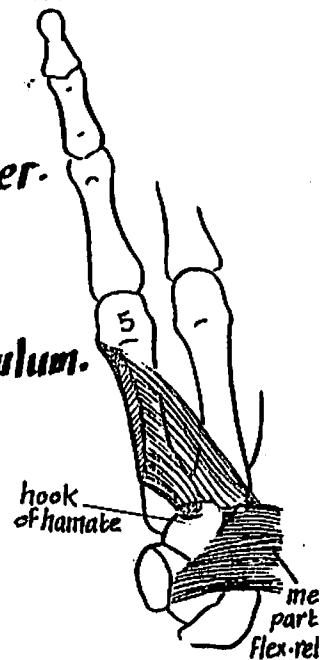
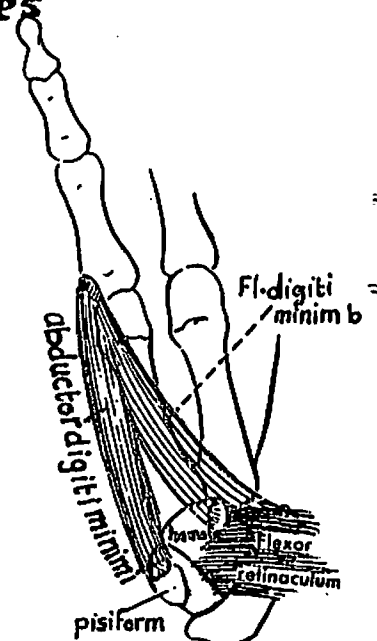
(3) Opponens digiti minimi :

* Origin : hook of hamate & the medial part of the flexor retinaculum.

* Insertion : into the med. border of the 5th metacarpal bone.

* N. supply : deep br. of ulnar nerve.

* Action : pulls the 5th metacarpal bone forwards & rotates it laterally to deepen the hollow of the palm



II--MUSCLES OF THE INTERMEDIATE COMPARTMEN

- they include the following:

(A) Lumbrical muscles : are 4 slender muscles arising from the tendons of flexor digitorum profundus in the palm.

(B) the interosseous muscles : are the muscles filling the spaces between the metacarpal bones & include : (a) 4 palmar interosseous muscles.

(b) 4 dorsal " "

A--LUMBRICAL MUSCLES

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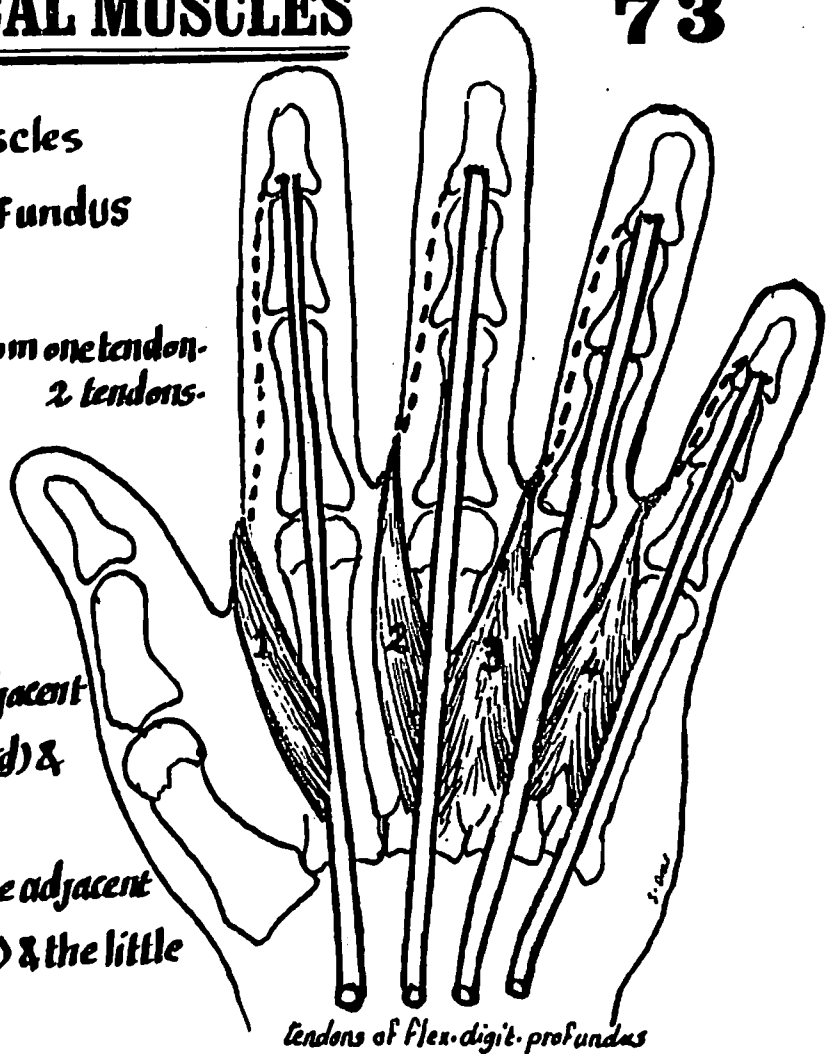
* They are 4 slender worm-like muscles arising from the flexor digitorum profundus tendons in the palm

* Origin: $\left\{ \begin{array}{l} \text{1st \& 2nd : each arises from one tendon.} \\ \text{3rd \& 4th " " " 2 tendons.} \end{array} \right.$

- the 1st & 2nd lumbricals arise from the lat. sides of the profundus tendons for index (2nd) & middle (3rd) fingers respectively.

- the 3rd lumbrical arises from the adjacent sides of the tendons for the middle (3rd) & the ring (4th) fingers.

- the 4th lumbrical m. arises from the adjacent sides of the tendons of the ring (4th) & the little (5th) fingers.



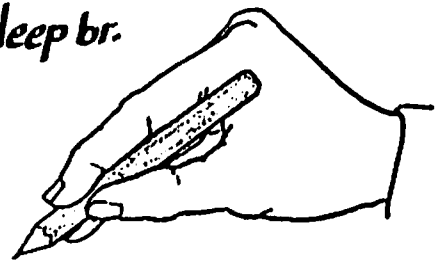
* Insertion:

each tendon passes backwards across the lat. side of the M.P. joint to reach the lat. side of the extensor expansion on the back of the finger. Each tendon joins the lat. slip of the extensor expansion through which it reaches its insertion in the base of the terminal phalanx (of all fingers except the thumb).

* N. Supply: - the lat. 2 lumbricals are supplied by the digital branches of median n. (from their superficial surface).

- the 2 med. lumbricals are supplied by the deep br. of ulnar n. (from their deep surfaces).

* Action: Flexion of the M.P. joints & extension of the I.P. Joints (putting the hand in writing position)



B--INTEROSSEOUS MUSCLES

* Site: they lie in the spaces between the metacarpal bones.

* Number: * the palmar interossei are 4 in number however, the 1st palmar interosseous m. is oftenly absent so, only 3 muscles may be present.
* the dorsal interossei are usually 4 & larger than the ventral muscles.

(A)-Palmar Interossei

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(1) 1st palmar interosseous m.

- it is a slender m. which may be absent.

* Origin : med. side of base of 1st metacarpal bone.

* Insertion : med. side of base of proximal phalanx of the thumb.

(2) 2nd palmar interosseous m. :

* Origin : med. side of the 2nd metacarpal bone.

* Insertion : into the med. side of the extensor expansion of the index finger.

(3) 3rd & 4th palmar interosseous muscles :

* Origin : from the lat. sides of the 4th & 5th metacarpal bones respectively.

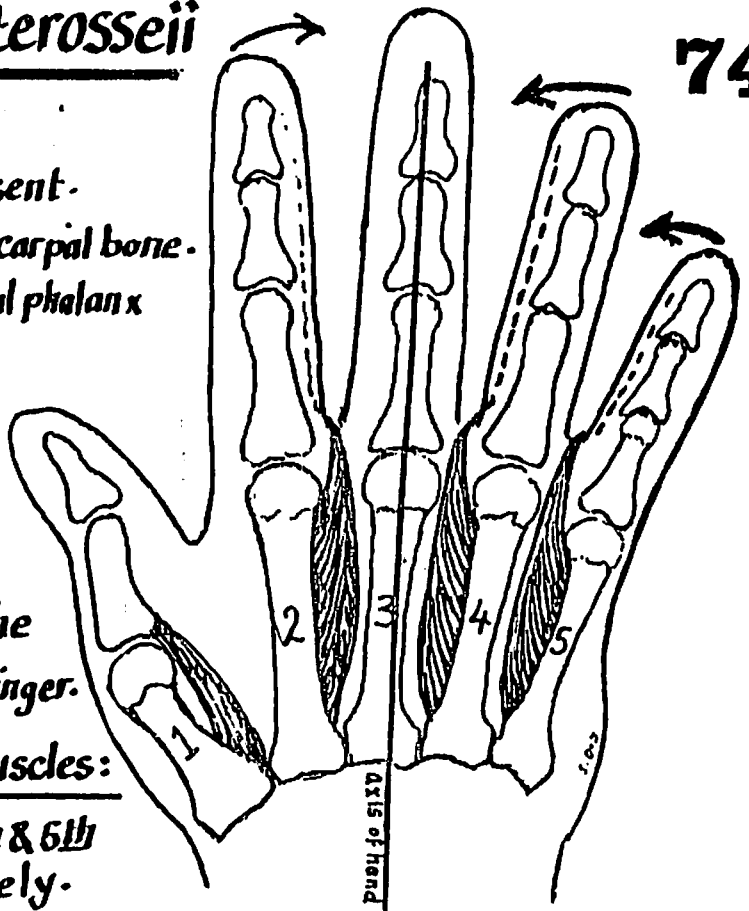
* Insertion : into lat. sides of extensor expansions of the ring & little fingers respectively.

* N. supply : deep br. of ulnar n.

* Action of the palmar interossei :

(1) Flexion of the M.P. joints of the index, ring & little fingers

(2) adduction of the thumb, index, ring & little fingers towards the middle line of the hand which is the middle line of middle finger.



(B)-Dorsal Interossei

* Origin : each muscle arises by 2 heads from 2 metacarpal bones

- the 1st arises from the metacarpals 1, 2

- " 2nd " " " " 2, 3

- " 3rd " " " " 3, 4

- " 4th " " " " 4, 5

* Insertion : into the extensor expansions :

- the 1st : into lat. side of ext. exp. of index f.

- " 2nd : " " " " " middle f.

- " 3rd : " med. " " " " middle f.

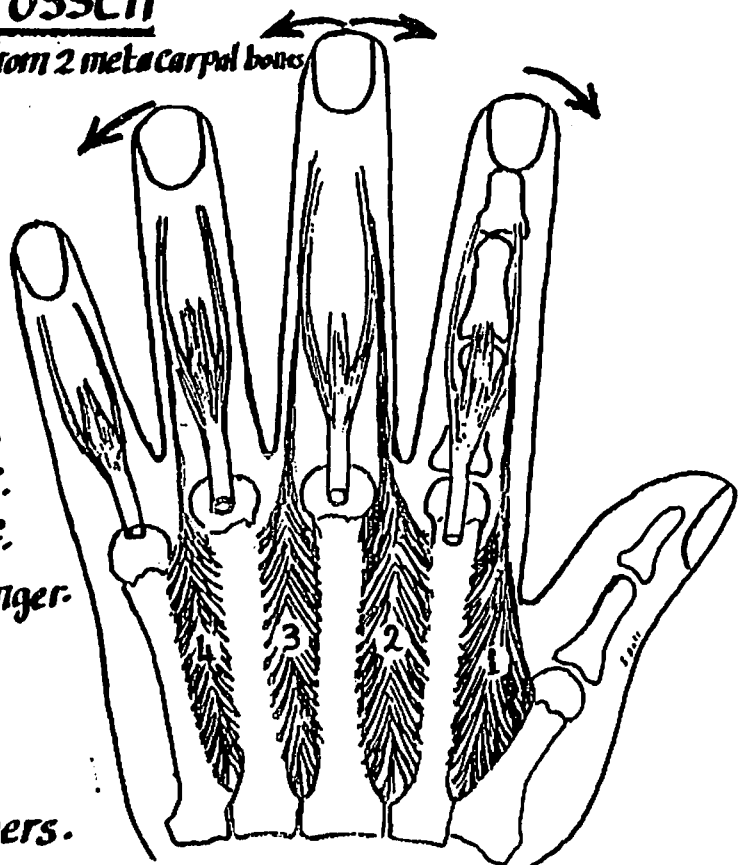
- " 4th : " med. " " " " little finger.

* N. Supply : deep br. of ulnar n.

* Action :

(1) abduction of index, middle & ring fingers.

(2) together with the palmar interossei & the lumbricals, they flex the M.P. joints & extend the I.P. joints (putting the hand in the writing position).



1- AXILLARY ARTERY

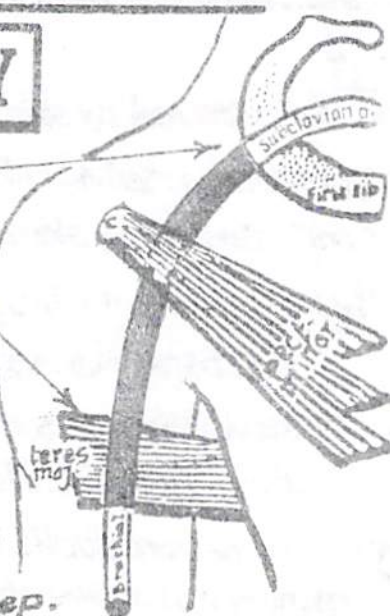
* **Beginning:** at the outer border of the first rib.
as a direct continuation of the subclavian a.

* **Termination:** at the lower border of teres major m.
by becoming the brachial artery.

* **Course:** it enters the axilla through its apex then runs along its lateral wall

- Its course is divided by pectoralis minor m. into 3 parts:

- (1) **First part:** lies above pectoralis minor & is very deep.
- (2) **Second "** : lies behind " & is deep
- (3) **Third "** : lies below " & is more superficial.



RELATIONS OF AXILLARY A.

Relations of the 1st part :

A-Anteriorly:

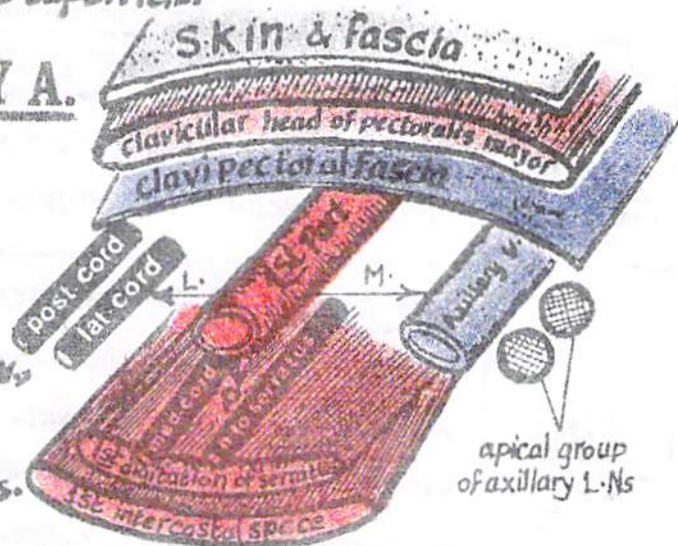
- (1) skin, superficial fascia & deep fascia.
- (2) Clavicular head of pectoralis major.
- (3) clavipectoral fascia & structures piercing it: cephalic v., lat. pectoral n. & axillary v.
- (4) Communicating loop between lat. & med. pectoral nerves.

(B) Posteriorly:

- (1) 1st digitation of serratus ant. (2) 1st intercostal space
- (3) nerve to serratus ant. m. (3) med. cord of the brachial plexus.

(C) **Medially:** axillary V. & apical group of axillary L.Ns.

(d) **Laterally:** lat. & post. cords of the brachial plexus. (lie lat. & above the artery).



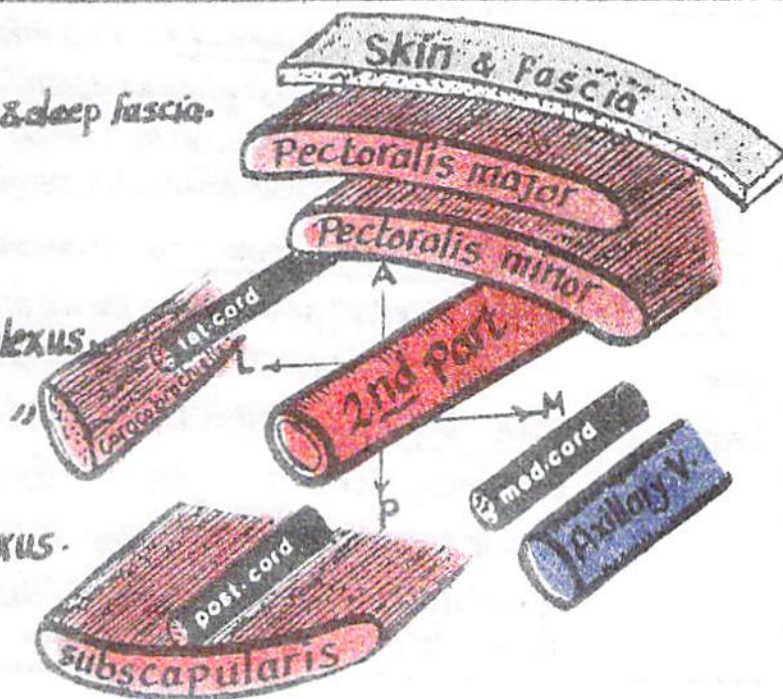
Relations of the 2nd part :

- (A) **Anteriorly:**
- (1) skin, superficial fascia & deep fascia.
 - (2) pectoralis major m.
 - (3) pectoralis minor m.

- (B) **Posteriorly:**
- (1) subscapularis m.
 - (2) post. cord of brachial plexus.

- (C) **Medially:**
- (1) med. cord of "
 - (2) axillary vein.

- (d) **Laterally:**
- (1) lat. cord of brachial plexus.
 - (2) coracobrachialis m.



III- Relations of the 3rd part :

(A) Anteriorly:

- (1) its upper part : covered by skin, fascia, pectoralis major & crossed by med. root of median n.
- (2) its lower part : covered by skin & fascia only.

(B) posteriorly: (1) radial & axillary nerves

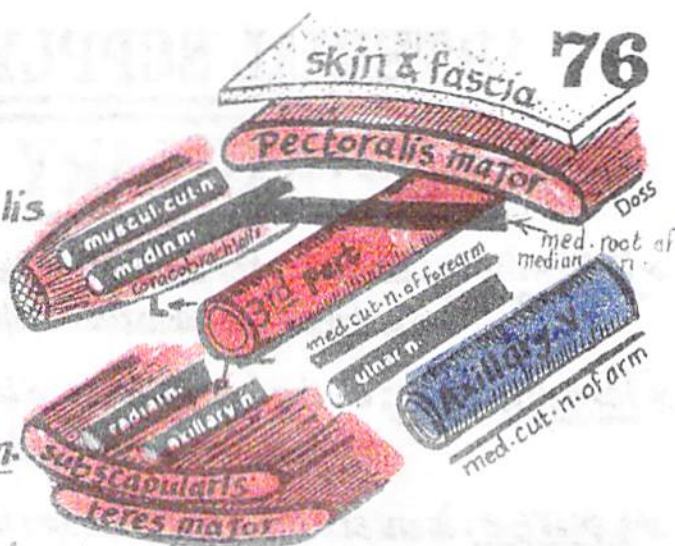
- (2) subscapularis & teres major mm.

(C) medially : (1) med. cutaneous n. of forearm.

- (2) ulnar n. (3) axillary v. (4) med. cut. n. of arm.

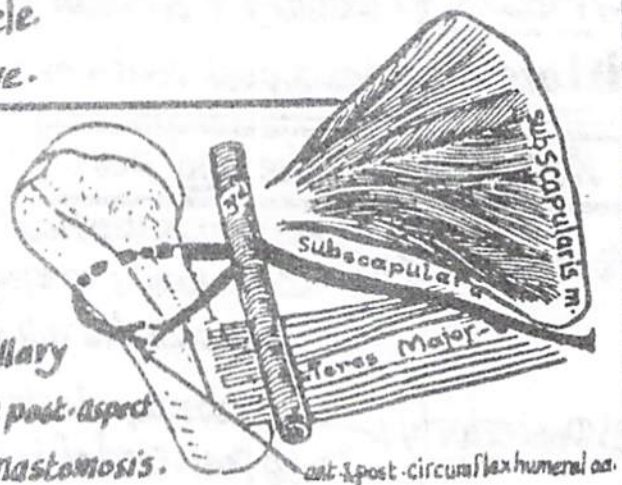
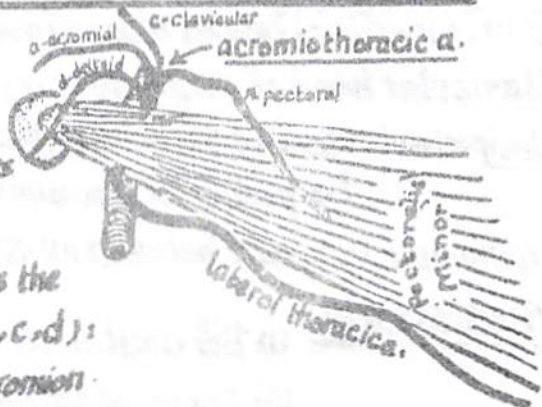
(d) laterally: coracobrachialis m. separated from the artery by the following nerves :

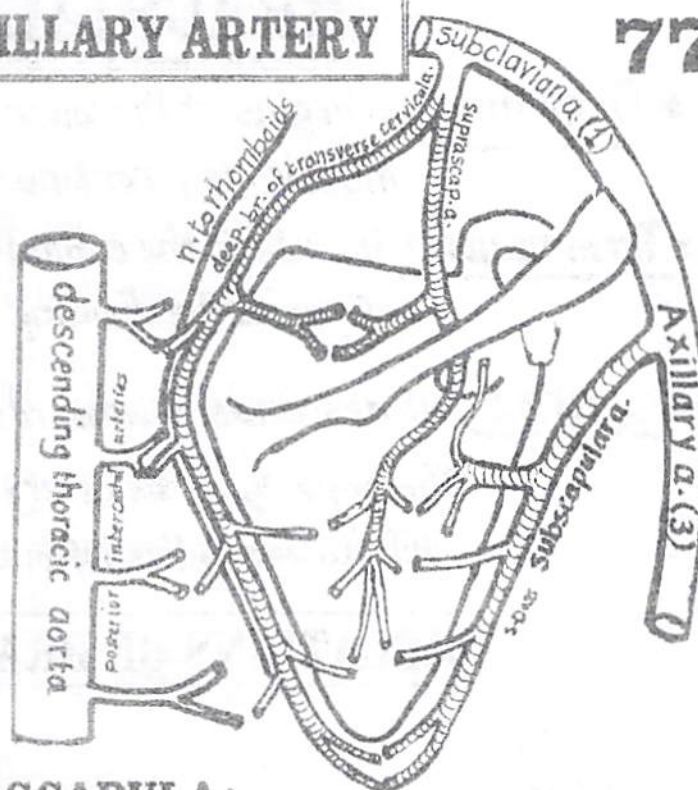
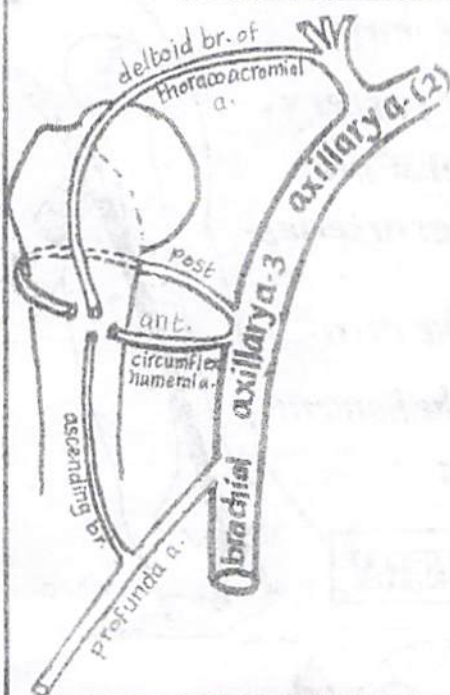
- (1) musculocutaneous n. (2) lat. root of median n. (3) median nerve.



BRANCHES OF AXILLARY ARTERY

Part	Branches
1st part gives one branch	- the <u>sup. thoracic a.</u> : a small br. which runs along the upper border of pectoralis minor to supply upper part of med. wall of axilla.
2nd part gives 2 branches	(1) <u>lat. thoracic a.</u> : runs along the lower border of pectoralis minor to reach the chest wall & accompany n. to serratus ant. It supplies muscles & sends external mammary branches to the breast. (2) <u>acromio-thoracic a.</u> : a short trunk which pierces the clavipectoral fascia then divides into 4 branches (a, p, c, d): (a) <u>acromial br.</u> : runs deep to deltoid m. to reach the acromion. (b) <u>pectoral br.</u> : runs between pectoralis major & minor muscles. (c) <u>clavicular br.</u> : the nutrient a. of the clavicle. (d) <u>deltoid br.</u> : runs in the deltopectoral groove.
3rd part gives 3 branches	(1) <u>ant. circumflex humeral a.</u> : runs in front of the surgical neck. It gives an ascending br. (runs in the bicipital groove) then enters the cruciate anastomosis around the surgical neck. (2) <u>post. circumflex humeral a.</u> : passes with axillary n. in the quadrangular space & curves around the post. aspect of the surgical neck then enters the cruciate anastomosis. (3) <u>Subscapular a.</u> : it is the largest br. of axillary a. It runs along the lower border of subscapularis m. It gives off the circumflex scapular br. (shares in the anastomosis around scapula) then continues as the thoracodorsal a. accompanying the thoracodorsal n. (n. to latissimus dorsi). The nerve & artery finally pierce the latissimus dorsi close to the inf. angle of the scapula.





1. ANASTOMOSIS AROUND THE SCAPULA:

* it is an important anastomosis between branches of the following arteries:

(a) 1st part of subclavian a. (b) 3rd part of axillary a. (c) descending Aorta.

(A) Branches from 1st part of subclavian a.

(1) deep br. of transverse cervical a. : arises from the thyrocervical trunk. it descends along the med. border of Scapula (accompanied by n. to rhomboids) It gives branches to both surfaces of the scapula.

(2) suprascapular a. : arises also from thyrocervical trunk. It reaches the upper border of the scapula (with its nerve) & gives branches in the supraspinous & infraspinous fossae.

(B) Branch from the 3rd part of axillary a.

- the subscapular a. which descends along the lower border of subscapularis m. It gives many anastomotic branches, the largest of which is circumflex scap. a. scapular a. to the infra spinous fossa.

(C) the post. intercostal branches of the descending thoracic aorta also share in the anastomosis around scapula.

* Importance of this anastomosis : it secures blood supply to the U.L in case of obstruction of the artery (between the origin of thyrocervical trunk & the subscapular a.

2. ANASTOMOSIS AROUND THE SURGICAL NECK (CRUCIATE ANASTOMOSIS) :

- it is formed by the following aa. : (a) ant. circumflex humeral a. (b) post. circumflex humeral a (c) deltoid br. of thoracoacromial a. (d) ascending br. of profunda brachii
- the 1st 3 arteries are branches of axillary a while the 4th is br. of brachial a.

BRACHIAL ARTERY

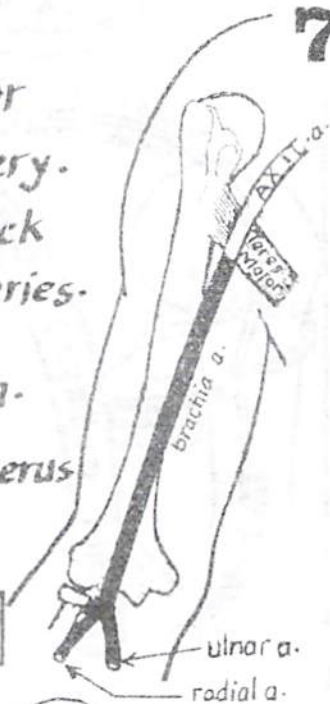
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* Beginning : it begins at the lower border of *teres major* muscle as a continuation of axillary artery.

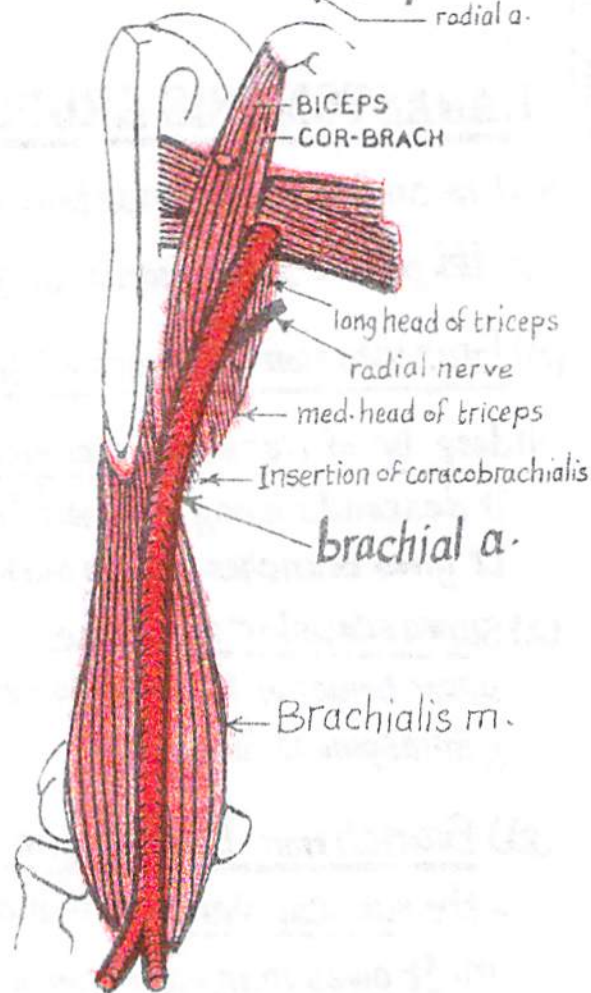
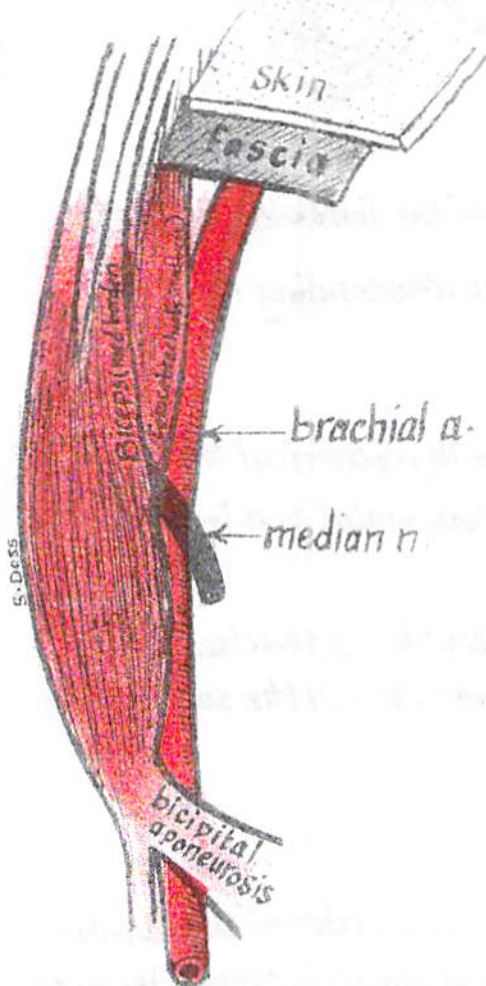
* Termination : it ends in the cubital fossa at the level of neck of radius by dividing into radial & ulnar arteries.

* Course : it descends downwards & laterally in the arm.

The upper $\frac{1}{2}$ of the artery lies medial to the humerus while its lower $\frac{1}{2}$ lies in front of the humerus.



RELATIONS OF BRACHIAL ARTERY



(A) Anterior relations:

- (1) Skin, superficial fascia & deep fascia.
- (2) med. margins of coracobrachialis & biceps.
- (3) median n. : Crosses the artery at the insertion of coracobrachialis.
- (4) bicipital aponeurosis crosses the artery in the cubital fossa (separating the artery from the median cubital vein).

(B) Posterior relations:

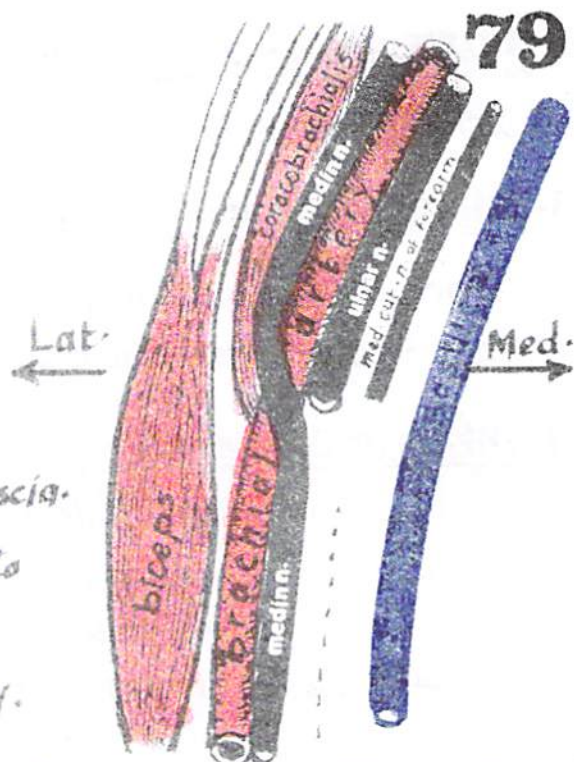
- From above downwards, it descends on:
- (1) long head of triceps with the radial n. & profunda artery in between.
 - (2) medial head of triceps.
 - (3) insertion of coracobrachialis m.
 - (4) brachialis m. : in the lower $\frac{1}{2}$ of arm & in the cubital fossa.

(C) lateral relations:

- (1) median nerve
- (2) coracobrachialis } lat. to the upper $\frac{1}{2}$
- (3) biceps muscle : lat. to the lower $\frac{1}{2}$

(D) Medial relations:

- (1) basilic v. : med. to the upper $\frac{1}{2}$ of the artery but separated from the lower $\frac{1}{2}$ by the deep fascia.
- (2) ulnar n. & med. cutaneous n. of forearm : medial to the upper $\frac{1}{2}$ of the artery.
- (3) median n. : medial to the lower $\frac{1}{2}$ of the artery.



BRANCHES OF BRACHIAL ARTERY

(1) Profunda brachii a. (the largest br. of brachial a.):

* Origin: from the posteromedial aspect of the brachial a. just below its beginning.

* Course & relations:

- accompanied by the radial n., it passes downwards, laterally & backwards 1st between long & med. heads of triceps then it runs in the spiral groove on the back of humerus between the lat. & med. heads of triceps.

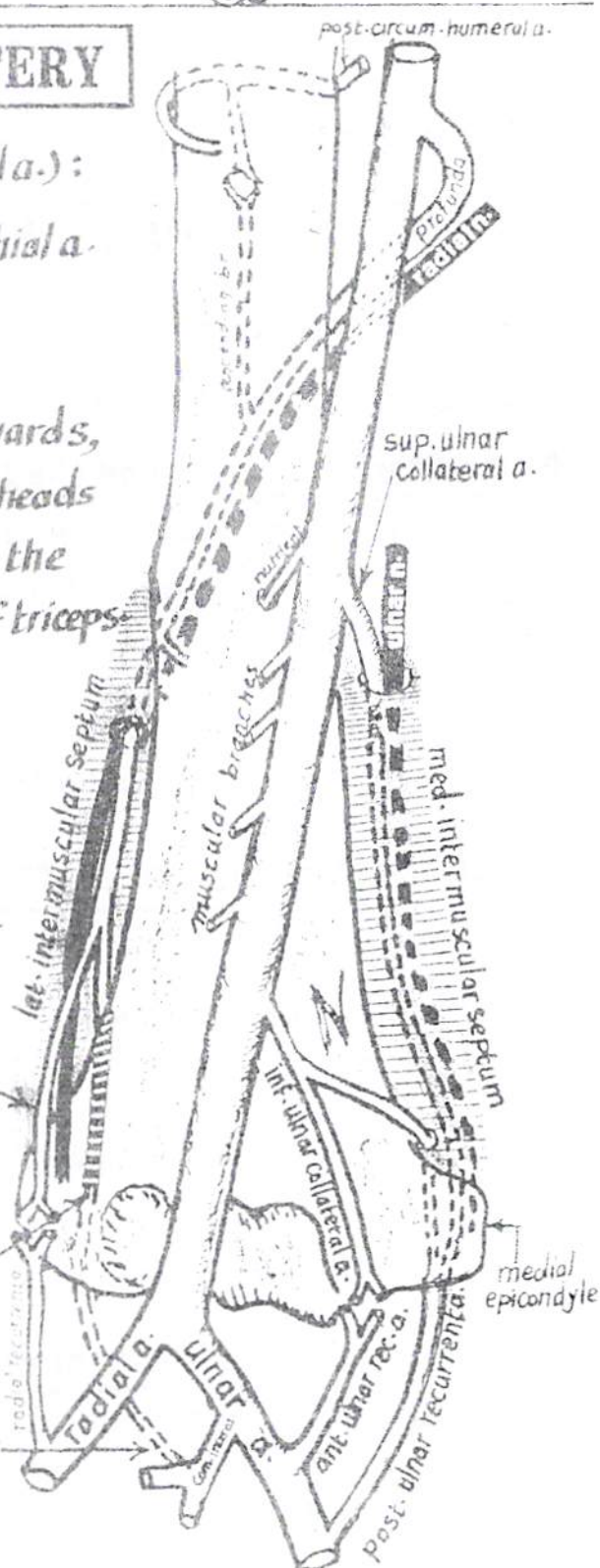
* Branches of profunda artery:

(a) ascending br. : anastomoses with the post. circumflex humeral a.

(b) nutrient a. : enters a nutrient foramen just behind deltoid tuberosity.

(c) ant. descending br. (radial collateral a.)
accompanies radial n. in front of lat. epicondyle to anastomose with the radial recurrent br. of the radial a.

(d) post. descending (middle collateral a.)
descends behind the lat. epicondyle to anastomose with the post. interosseous recurrent a.



2- Nutrient a. of the humerus: it arises about the middle of the arm & enters the humerus near the insertion of coracobrachialis.

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3- Sup. ulnar collateral a.: arises a little below the middle of arm.

It accompanies ulnar n. down to the back of the med. epicondyle & ends by anastomosing with the post. ulnar recurrent a.

4- Inf. ulnar collateral a.:

- arises from the med. side of the brachial a. about 2" above the elbow

- it divides into ant. & post. branches:

a. the ant. br. descends in front of the med. epicondyle to anastomose with ant. ulnar recurrent artery.

b. the post. br. pierces the med. intermuscular septum to reach the back of med. epicondyle to anastomose with the post. ulnar recurrent a.

5- Muscular branches: to the muscles & skin of the arm.

ANASTOMOSIS AROUND THE ELBOW

* it is a rich anastomosis which connects the brachial a. above with the upper ends of radial & ulnar arteries below. It includes:

(A) the anastomosis around the lat. epicondyle of humerus:

lies both in front & behind the lat. epicondyle

1 - in front the lat. epicondyle: the ant. descending br. of profunda (radial collateral) anastomosis with the radial recurrent br. of radial a.

2 - behind the lat. epicondyle: the post. descending br. of profunda anastomoses with post. interosseous recurrent a. (br. of post. interosseous a.)

(B) the anastomosis around the medial epicondyle:

lies both in front & behind the med. epicondyle.

1 - in front the med. epicondyle: the ant. br. of inf. ulnar collateral a. anastomoses with the ant. ulnar recurrent br. of ulnar artery.

2 - behind the med. epicondyle: the sup. ulnar collateral a. & the post. br. of inf. ulnar collateral a. anastomose with the post. ulnar recurrent br. of ulnar artery.

(C) Transverse anastomosis: is established between the post. descending br. of profunda & the post. br. of inf. ulnar collateral a. this anastomosis lies behind elbow just above the olecranon fossa.

* **Origin**: it begins in the cubital fossa at the level of neck of radius as the larger of the 2 terminal branches of the brachial artery.

* **Termination**: it ends in the palm by becoming the superficial palmar arch.

* **Course**:

(1) in the upper $\frac{1}{3}$ of the forearm, it runs obliquely downwards & medially.

(2) in the lower $\frac{2}{3}$ of forearm, it runs vertically downwards along the ulnar side

(3) At the wrist: it pierces the deep fascia & descends superficial to the Flexor retinaculum.

(4) In the hand: it curves from medial to lateral forming the superficial palmar arch just deep to the palmar aponeurosis.

* RELATIONS OF THE ULNAR A.

I- Anterior (superficial) relations in forearm:

(a) its upper oblique part is crossed by the muscles arising from the common Flexor origin (except Fl. Carpi ulnaris) i.e.:

- (1) pronator teres (with median n. between its 2 heads),
- (2) flexor carpi radialis (3) palmaris longus
- (4) flexor digitorum superficialis.

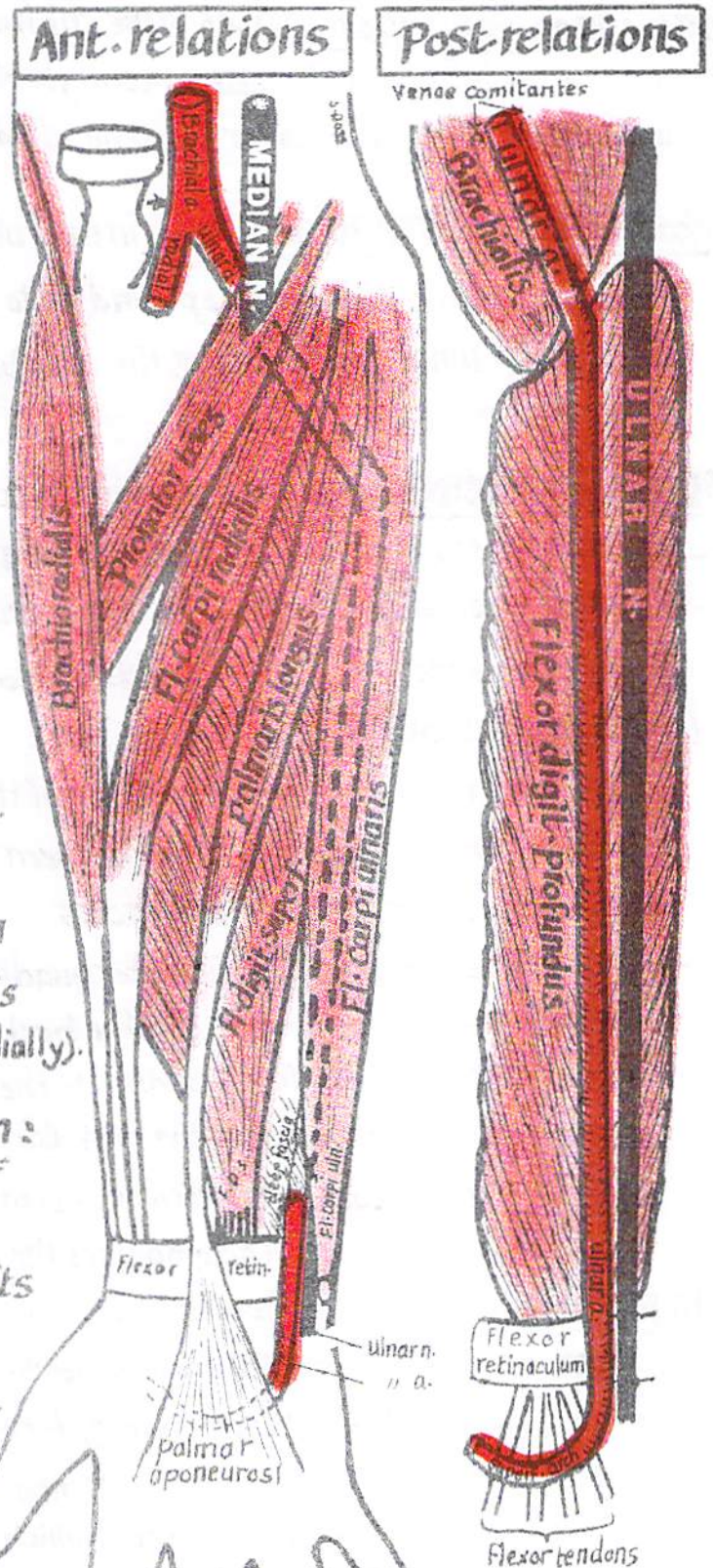
(b) its lower vertical part: is overlapped by the flexor carpi ulnaris.

(c) Short distance above the wrist: the ulnar a. becomes superficial (covered by skin & fascia only) & lying in the space between the tendons of flexor digitorum superficialis (laterally) & the tendon of Fl. Carpi ulnaris (medially).

II- Deep (posterior) relations in forearm:

- (1) Brachialis m.: in the cubital fossa.
- (2) flexor digitorum profundus: behind its lower $\frac{2}{3}$ in the forearm.
- (3) flexor retinaculum behind it at wrist.

N.B: the ulnar artery is accompanied by 2 venae comitantes throughout its course.



* Relations of the ulnar a. to the ulnar nerve: the nerve lies med. to the artery:

- (a) in the upper $\frac{1}{3}$ of the forearm: they are separated by a triangular interval.
 (b) " " lower $\frac{2}{3}$ " " " : ulnar n. lies close to the med. side of the artery.

* Relation of ulnar a. to the median nerve:

- (a) the median n. lies med. to the ulnar a. in the cubital fossa.
 (b) as the median n. leaves the fossa by passing between the 2 heads of pronator teres, it lies superficial to the artery & separated from it by the ulnar head of pronator teres.

BRANCHES OF ULNAR ARTERY

(1) ant. ulnar recurrent a. (arises in the cubital fossa):

It ascends in front of the med. epicondyle of humerus to anastomose with the inf. ulnar collateral a. (br. of brachial a.).

(2) Post. ulnar recurrent a. (arises in the cubital fossa):

it ascends behind the med. epicondyle to anastomose with the sup. ulnar collateral a. & the post. br. of inf. ulnar collateral a.

(3) Common interosseous a. (arises in the cubital fossa):

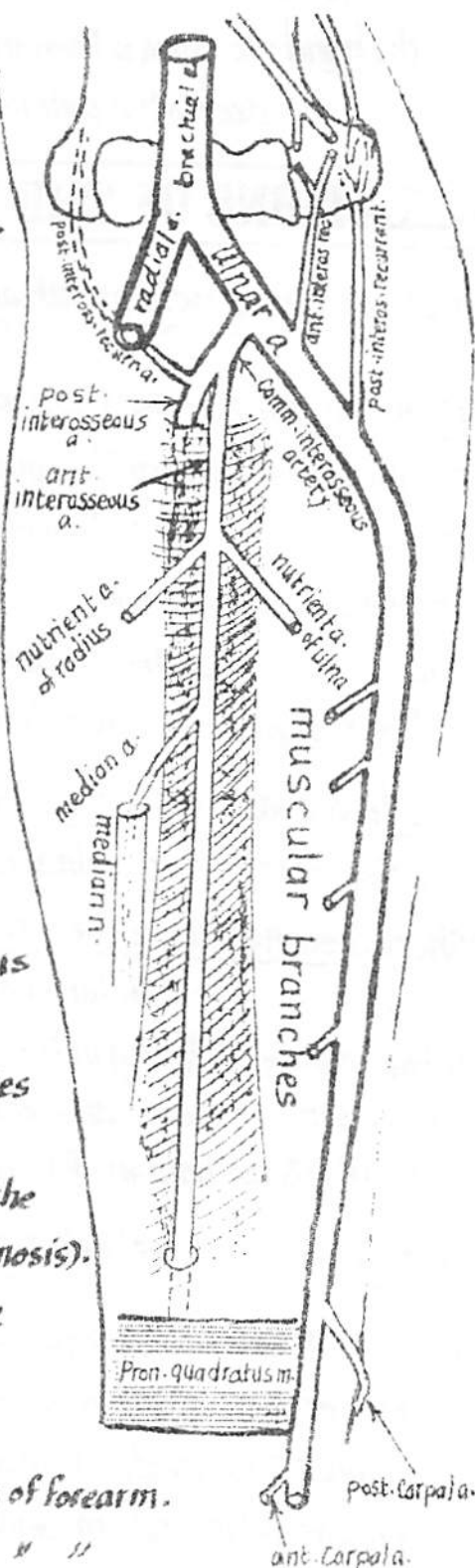
- it is a short trunk arising 1" below the origin of ulnar a.
- it passes backwards to reach the upper margin of the interosseous memb. where it divides into 2 branches:

(a) ant. interosseous a. (the larger br.):

- runs downwards on the ant. surface of the interosseous memb. (accompanied by its nerve) between the Fl. pol. longus & Flexor digitorum profundus muscles.
- at the upper border of the pronator quadratus m. it pierces the interosseous memb. to reach the back of the forearm where it joins the post. interosseous n. then descends on the dorsum of the carpus to join the post. Carpal arch (anastomosis).
- branches: (1) muscular (2) nutrient a. to radius & ulna & the median a. which accompanies the median n.

(b) post. interosseous a.: (the smaller br.):

- it passes backwards above the inteross. memb. to reach the back of forearm.
- then it descends between the superficial & deep muscles of " " " "
- it ends by anastomosing with the ant. interosseous a. & the post. Carpal arch.
- branches: (1) post. inteross. recurrent a. which anastomoses with the post. br. of profunda a. behind the lat. epicondyle. (2) muscular brs. to muscles of back of fore arm.



(4) Muscular branches : to the nearby muscles.

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(5) Anterior (palmar) Carpal a. : arises at the wrist & runs laterally to anastomose with the ant. (palmar) br. of the radial a. in front of the Carpus to form the ant. Carpal arch.

(6) Posterior (dorsal) Carpal a. : arises just above the pisiform bone then curves backwards deep to the Flexor carpi ulnaris tendon to anastomose with the dorsal carpal br. of the radial a. behind the wrist forming the post. Carpal arch.

ULNAR ARTERY IN THE HAND

* Course & relations :

1 - the ulnar a. enters the hand by crossing superficial to the med. part of the Flexor retinaculum, having the following relations :

- medially : it is related to ulnar n. & pisiform bone.
- superficially : it is covered by skin, fascia & palmaris brevis m.
- deeply : it is related to the Flexor retinaculum.

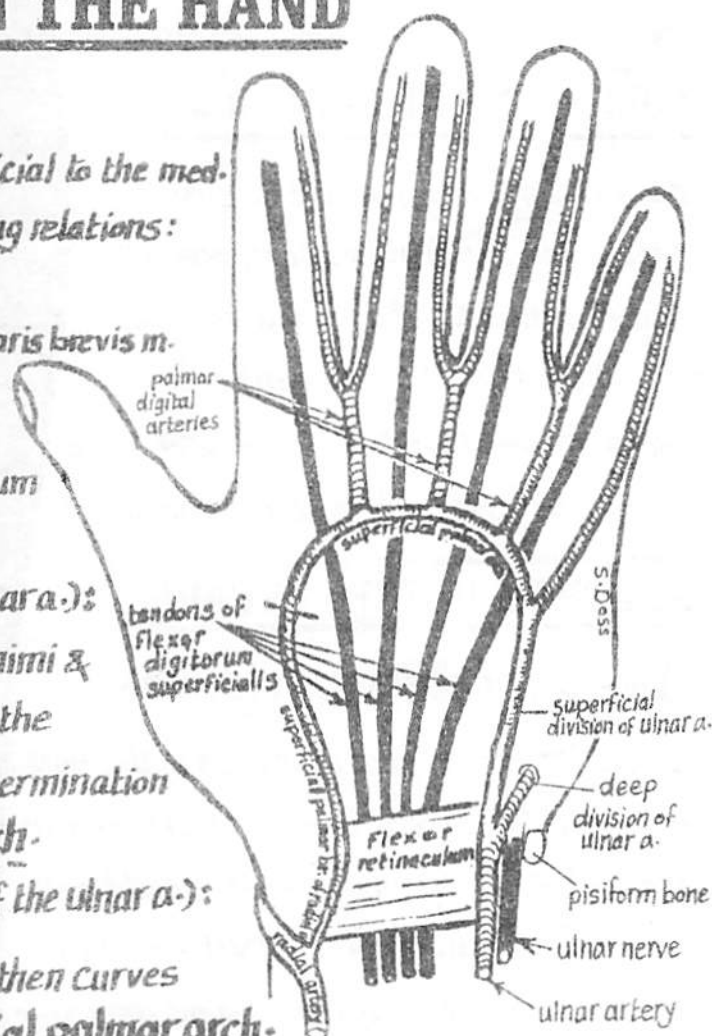
2 - the ulnar a. divides in front of the Flexor retinaculum into deep & superficial divisions :

(A) the deep division (called deep palmar br. of ulnar a.) :

it dips backwards between the abd. digiti minimi & Flexor digiti minimi brevis then passes through the opponens digiti minimi to anastomose with the termination of the radial a. forming the deep palmar arch.

(B) the superficial division (the continuation of the ulnar a.) :

runs distally just med to the hook of hamate, then curves laterally across the palm to form the Superficial palmar arch.



SUPERFICIAL PALMAR ARCH

* Site & relations : it lies immediately deep to the palmar aponeurosis & crosses superficial to the digital branches of the median n. & the long flexor tendons together with the common synovial sheath surrounding them.

* Formation : it is formed mainly by the arch of the superficial division of the ulnar artery & is completed by the superficial palmar br. of the radial artery.

* Branches :

(1) palmar digital a. to the med. side of the little finger.

(2) 3 common palmar digital arteries which run in the 2nd, 3rd & 4th intermetacarpal spaces to reach the clefts between the med. 4 fingers. Each artery is joined by a palmar metacarpal artery from the deep palmar arch then it divides into 2 digital arteries which run along the adjacent sides of 2 fingers.

ORIGIN : it begins in the cubital fossa at the level of neck of radius as the smaller of the 2 terminal branches of the brachial artery.

TERMINATION : it ends in the palm by becoming the deep palmar arch.

COURSE IN THE FOREARM :

it descends along the radial side of the front of forearm (accompanied by 2 Venae Comitantes) till it reaches the wrist where its pulsations can be felt between the lower part of ant-border of radius (laterally) & fl. carp. radialis tendon (medially)

RELATIONS IN THE FOREARM :

(A) Deep (posterior) relations:

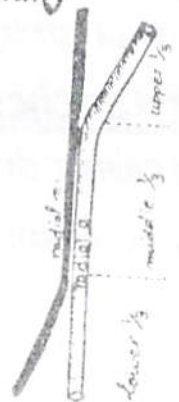
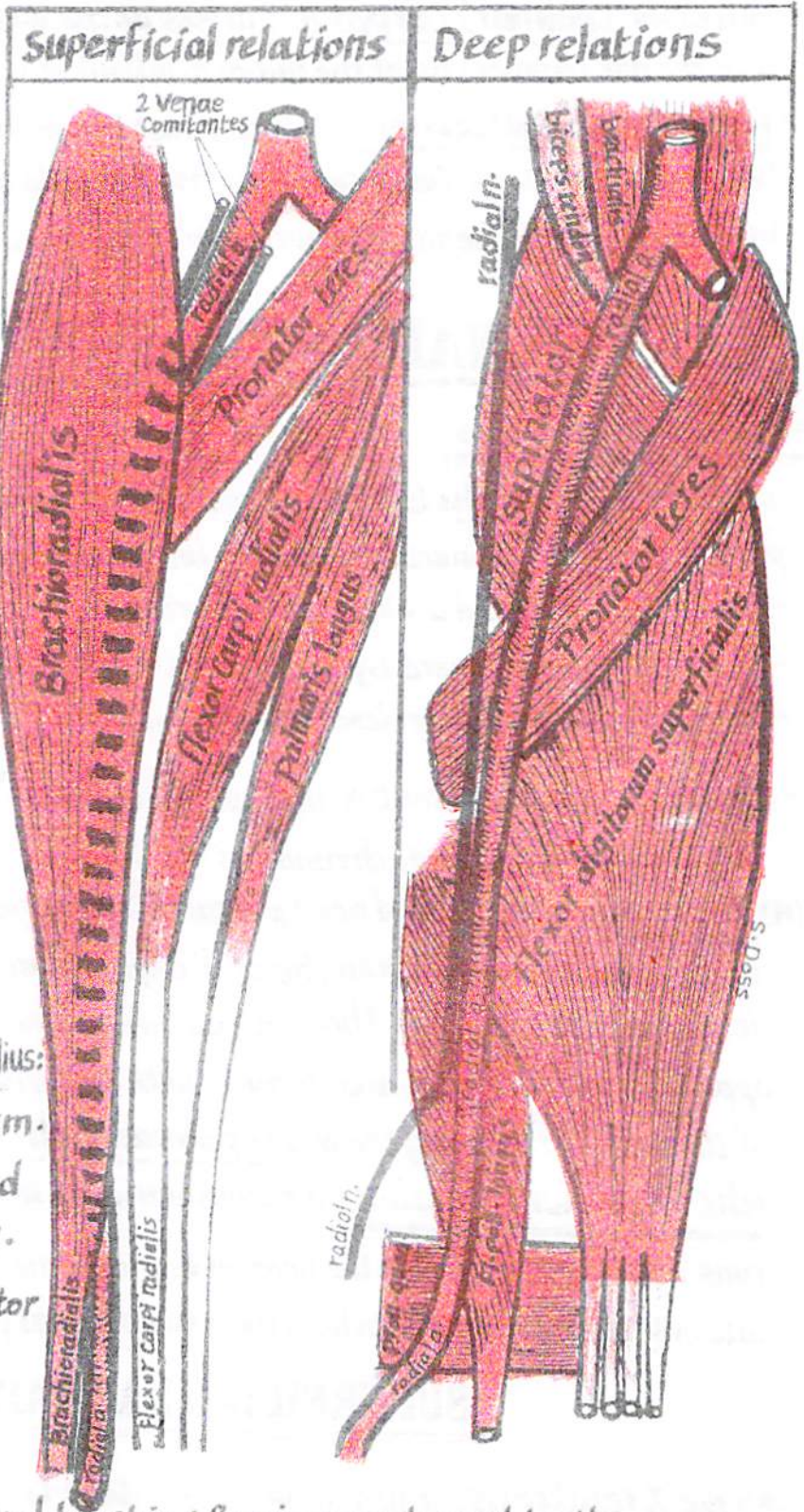
- it is related to muscles attached to the radius:
- in the upper $\frac{1}{3}$: biceps tendon & Supinator m.
- in the middle $\frac{1}{3}$: pronator teres & radial head of flexor digitorum superficialis m.
- in the lower $\frac{1}{3}$: flexor pollicis longus, pronator quadratus & the lower end of radius.

(B) Superficial (anterior) relations:

- (1) in the upper part of the forearm : it is covered by skin & fascia & overlapped by the brachioradialis (lying between brachioradialis laterally & pronator teres medially).
- (2) in the lower part of the forearm : the radial a. becomes superficial in position (covered by skin & fascia). Here it lies between the brachioradialis tendon laterally & flexor carpi radialis tendon medially.

(C) the relation between radial a. & radial nerve :

- (1) in the upper $\frac{1}{3}$: the radial n. is separated from radial a. by an interval.
- (2) " " middle $\frac{1}{3}$: the radial n. lies close to the lat. side of the radial a.
- (3) " " lower $\frac{1}{3}$: the radial n. leaves the artery by passing backwards around the lat. margin of forearm under cover of brachioradialis.



I- COURSE AND RELATIONS AT THE WRIST

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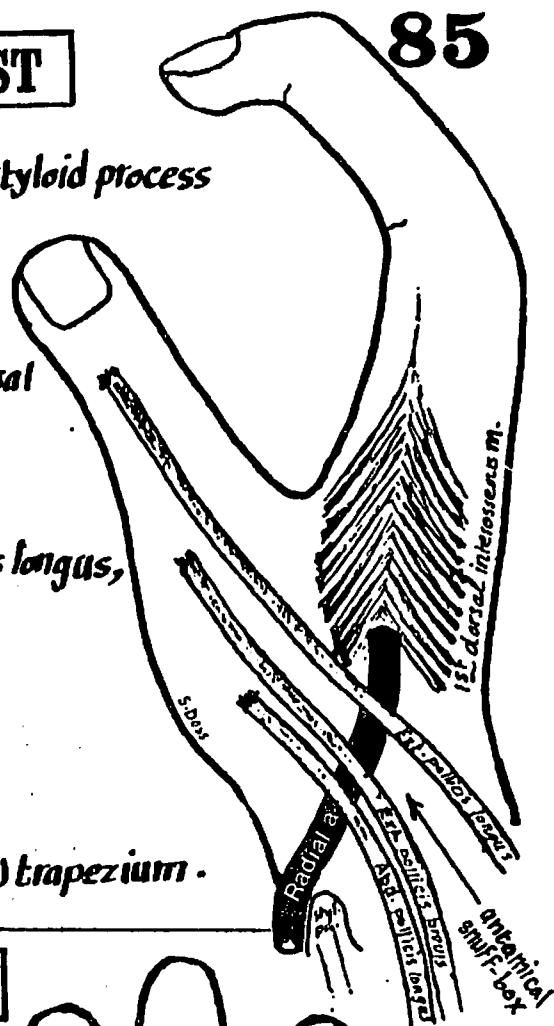
- At the wrist, the radial a. curves backwards below the styloid process of radius, enters the anatomical snuff-box to reach the proximal end of the of the 1st dorsal interosseous space.
- then it passes forwards between the 2 heads of the 1st dorsal interosseous m. to reach the palm of the hand.

* Superficial relations: it is crossed superficially by :

- (1) the tendons of the anatomical snuff-box (abd. pollicis longus, ext. pollicis brevis & ext. pollicis longus.
- (2) the digital branches of the superficial radial n.
- (3) the beginning of the cephalic v.

* Deep relations : it crosses :

- (1) the lat. lig. of the wrist joint (2) scaphoid bone (3) trapezium.



I- COURSE AND RELATIONS IN THE PALM

- * it appears in the palm between the 2 heads of add. pollicis
- * then it curves medially to anastomose with the deep br. of ulnar a. opposite the base of the 5th metacarpal bone to form the deep palmar arch.

THE DEEP PALMAR ARCH

- * it is an arterial arch formed by the union of the terminal part of the radial a. in the palm with the deep division of the ulnar a. (the radial a. forms the main part of the deep palmar arch).

* Site : it lies in front of the metacarpal bones just distal to their bases being concave proximally.

* Relations : the deep br. of ulnar n. lies in the concavity of the deep arch & both lie behind the flexor tendons, lumbrical muscles & the digital branches of median n.

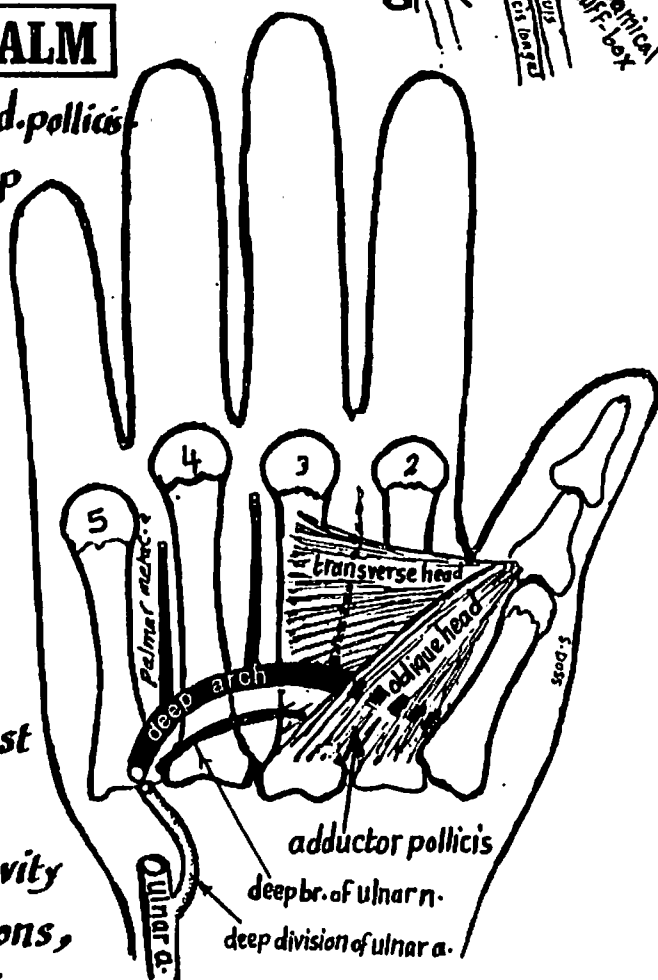
Surface anatomy: draw a line one inch proximal to the superficial palmar arch & parallel to

* Branches : (1) 3 palmar metacarpal aa.

(2) perforating arteries of the palm.

(3) recurrent branches

} See page 86

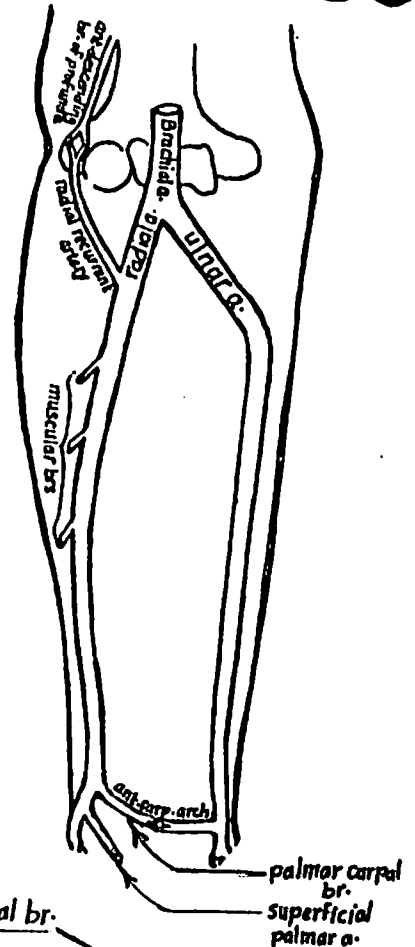


BRANCHES OF RADIAL ARTERY

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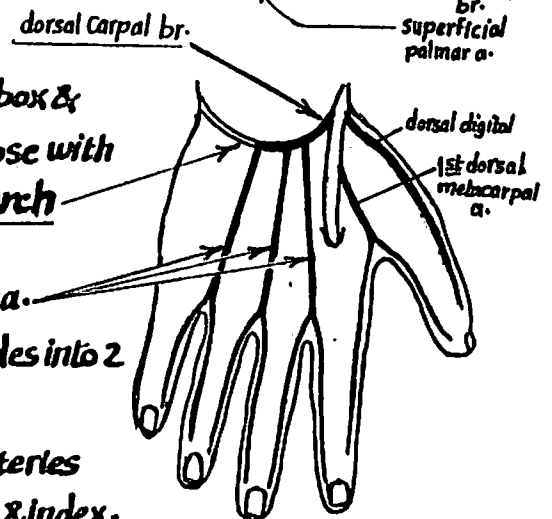
A) IN THE FOREARM:

- (1) radial recurrent a.: arises in the cubital fossa & ascends in front of the lat. epicondyle to anastomose with the ant. descending branch of the profunda brachii artery.
- (2) Muscular brs.: to the muscles attached to the radius.
- (3) Palmar (ant.) Carpal a.: arises near the lower border of pronator quadratus & runs medially deep to the long flexor tendons to anastomose with the palmar carpal br. of ulnar a. in front of the Carpus forming the ant. carpal arch which is joined by br. from ant. interosseous a. & by recurrent brs. from the deep palmar arch.
- (4) Superficial palmar a.: arises from the radial a. just before it curves backwards to reach the anatomical snuff box. It penetrates the thenar muscles to anastomose with the ulnar a. in the palm to complete the superficial palmar arch.



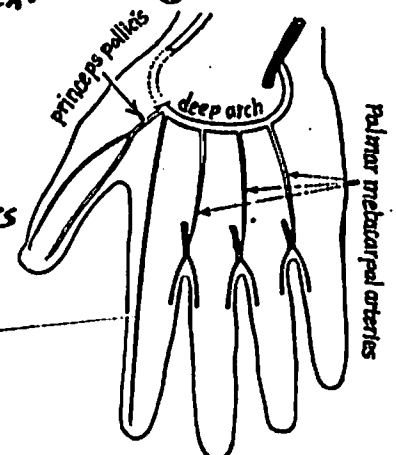
B) AT THE WRIST:

- (1) Dorsal (post.) Carpal br.: arises in the anatomical snuff box & passes medially across the back of the wrist to anastomose with the dorsal carpal br. of ulnar a. forming the dorsal carpal arch which receives the termination of the ant. interosseous a.
N.B.: the dorsal carpal arch gives rise to 3 dorsal metacarpal aa. to the 2nd, 3rd & 4th intermetacarpal spaces. Each a. divides into 2 dorsal digital arteries to the adjacent sides of 2 fingers.
- (2) 1st dorsal metacarpal a.: divides into 2 dorsal digital arteries to the adjacent sides of thumb & index.
- (3) dorsal digital a. to the lat. side of the thumb.



C) IN THE HAND:

- (1) princeps pollicis a.: arises immediately after the radial a. enters the palm. It divides into 2 digital brs. to supply the thumb.
- (2) radialis indicis a.: runs along the lat. side of the index finger.



D) BRANCHES OF THE DEEP PALMAR ARCH:

- (1) 3 palmar metacarpal aa.: pass in the 2nd, 3rd & 4th intermetacarpal spaces to join the palmar digital brs. of the superficial palmar arch at the M/p. joints.
- (2) 3 perforating brs.: pass backwards, perforating the interosseous muscles in the 2nd, 3rd & 4th spaces to join the dorsal metacarpal aa. on the dorsum of hand.
- (3) recurrent brs.: ascend in front of the wrist to join the palmar carpal arch.

(1) On the front of the wrist joint: the ant. carpal arch is formed by the anastomosis between the palmar carpal branches of both radial & ulnar arteries.

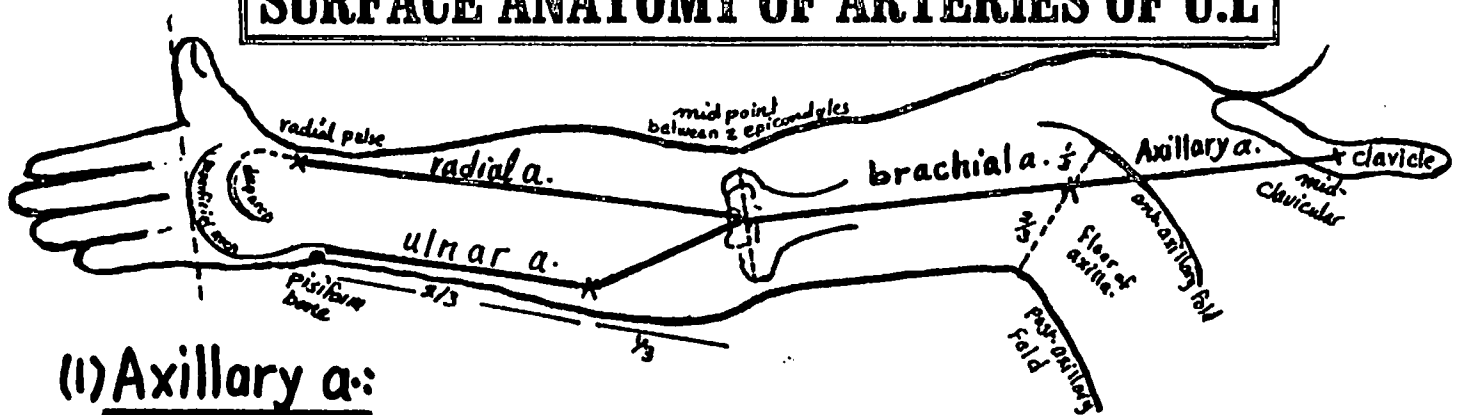
(2) On the back of the wrist joint: the dorsal carpal arch is formed by the anastomosis between the dorsal carpal branches of both arteries.

(3) In the hand:

(a) superficial palmar arch } form direct anastomoses between radial & ulnar arteries.
(b) deep palmar arch }

(c) anastomosis between the palmar digital arteries of the superficial arch & the palmar metacarpal arteries of the deep arch.

SURFACE ANATOMY OF ARTERIES OF U.L



(1) Axillary a.:

with the arm abducted 90° & the forearm supinated, draw a line from the mid-clavicular point to a point in the floor of axilla at the junction of the ant. $\frac{1}{3}$ & post. $\frac{2}{3}$ of a line connecting the ant. & post. axillary folds.

(2) Brachial a.: draw a line from the point of termination of axillary a. to a point in the cubital fossa midway between the 2 humeral epicondyles.

(3) Radial a.: draw a line extending from the point of termination of brachial a. to the point where the radial pulsation can be felt at the wrist.

(4) Ulnar a.:

(a) its upper oblique part: draw a line from the end of brachial a. to a point on the med. border of the forearm at the junction of the upper $\frac{1}{3}$ & lower $\frac{2}{3}$

(b) its lower vertical part: draw a line from the last point to a point just lat. to the pisiform bone.

(5) the Superficial palmar arch: draw a transverse line across the palm at the level of the distal border of the fully extended thumb.

(6) the deep palmar arch: draw a line one finger breadth proximal to the line of the superficial arch.

VEINS OF THE U.L

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I- SUPERFICIAL VEINS

1. THE SUPERFICIAL DORSAL VENOUS PLEXUS:

it is a network of veins in the superficial fascia on the dorsum of hand. It receives the dorsal digital & the metacarpal veins.

2. THE CEPHALIC VEIN:

* Origin: it arises from the lat. side of the dorsal venous plexus of the hand just behind styloid process of radius.

* Course & relations:

- (1) it ascends upwards superficial to the ext. retinaculum.
- (2) it curves around the lat. side of the wrist to reach the front of the forearm then ascends along its lat. side till it reaches the front of the elbow where it gives off its median cubital v. one inch below the elbow.
- (3) then it ascends in the arm along the lat. side of the biceps
- (4) it pierces the deep fascia in the upper part of the arm then continues upwards in the delto-pectoral groove.

* Termination: it ends in the infraclavicular fossa where it turns inwards piercing the clavipectoral fascia to end in the axillary v.

3. THE BASILIC VEIN:

* Origin: From the med. side of the dorsal venous plexus of hand.

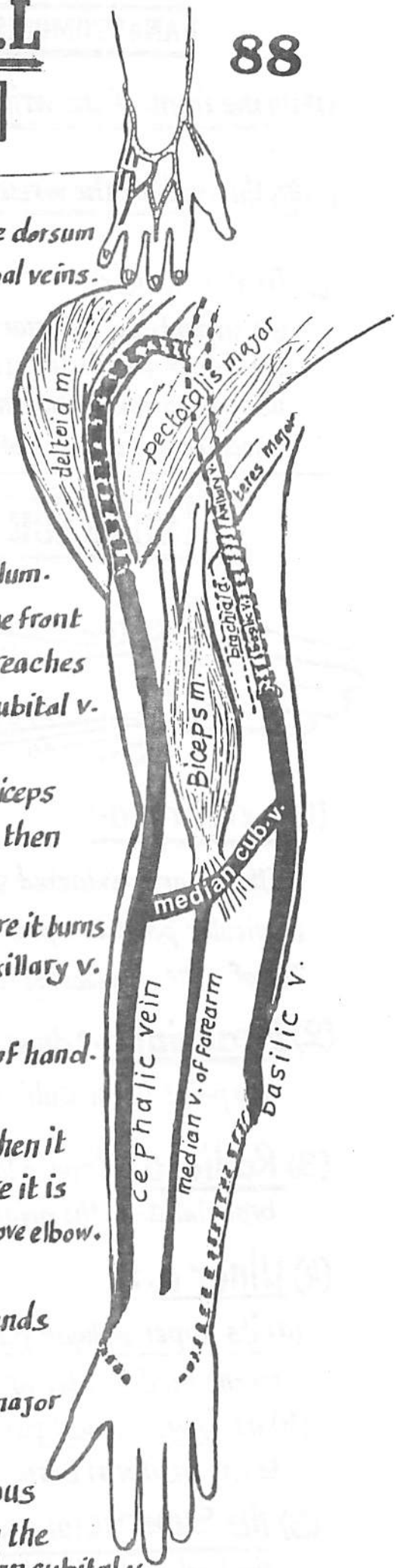
* Course & relations:

- (1) it ascends along the med. side of the back of forearm then it curves forwards to reach the front of the elbow where it is joined to the cephalic v. by the median cubital v. 1" above elbow.
- (2) then it ascends along the med. side of the arm till its middle where it pierces the deep fascia & ascends close to the med. side of the brachial a.

* Termination: it ends at the lower border of teres major m. by becoming the axillary v.

4. MEDIAN VEIN OF FOREARM: drains the subcutaneous tissue of the front of wrist & forearm. it ascends in the middle line of the front of forearm to end in the median cubital v.

5. MEDIAN CUBITAL VEIN: lies in the superficial fascia of the cubital fossa connecting the cephalic v. (1" below the elbow) with the basilic v. (1" above the elbow). It is the most prominent superficial v. in the body (used for intravenous injections).



* they are mainly *venae comitantes* accompanying the arteries:

- (1) *Venae Comitantes* of the deep palmar arch.
- (2) " " " " Superficial palmar arch.
- (3) *Venae comitantes of the ulnar artery*:
they drain the *venae comitantes* of the superficial palmar arch + ant. & post. interosseous veins.

- (4) *Venae Comitantes of the radial artery*:
they drain the *venae comitantes* of the deep palmar arch + the deep veins of the *dorsum* of hand.

- (5) *Venae Comitantes of the brachial artery*:
 - they are formed by the union of the *venae comitantes* of the radial & ulnar arteries in front of elbow.
 - they receive tributaries that correspond to the branches of the brachial artery.
 - they end by joining the axillary vein.

6. AXILLARY VEIN

* Beginning: at the lower border of *teres major m.* as a continuation of the *basilic vein*.

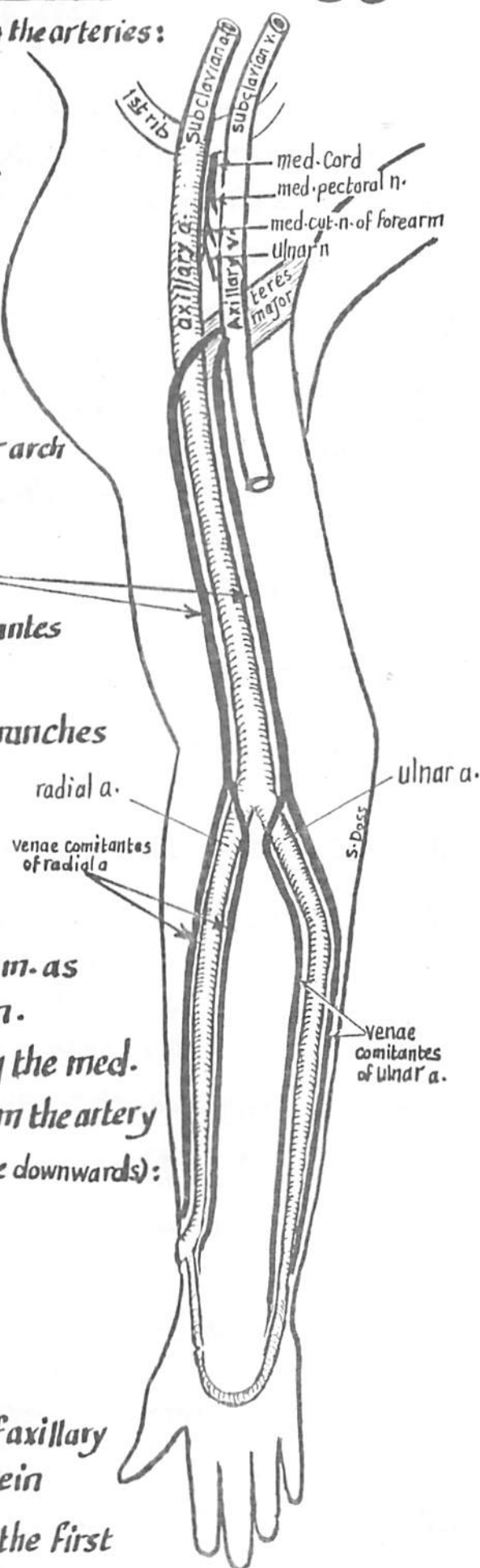
* Course & relations: it ascends upwards along the med. side of the axillary a. being separated from the artery by the following structures (enumerated from above downwards):

- (1) med. cord of the brachial plexus.
- (2) " pectoral nerve.
- (3) med. cut. n. of forearm.
- (4) ulnar n.

N.B: the med. cut. n. of arm & the lat. group of axillary lymph nodes lie medial to the axillary vein

* Termination: it ends at the outer border of the first rib by becoming the subclavian vein.

* Tributaries: (1) *Venae comitantes* of brachial a. (near its beginning).
(2) Veins corresponding to the branches of the axillary a.
(3) Cephalic vein: near its end.



NERVE SUPPLY OF U.L

(THE BRACHIAL PLEXUS)

90

* Definition of a nerve plexus: it is a complex arrangement of the ant-1^{ry} rami of certain spinal nerves, allowing mixing of fibres from different segments of the spinal cord & giving branches (carrying fibres from more than one segment of the spinal cord) to supply the muscles & skin of certain parts of the body.

* The Brachial Plexus: is a big network of nerves which lies partly in the neck & partly in the axilla and is concerned with the innervation of the skin & muscles of U.L

* Formation of the brachial plexus:

- it is formed of the ant-1^{ry} rami of the lower 4 cervical nerves + the 1st thoracic n. i.e C5, 6, 7, 8 & T1. This is the normal type of the brachial plexus
- the origin of the plexus may shift by one segment up by receiving a large contribution from C4. This is called Prefixed type of brachial plexus.
- the origin may shift by one segment down by receiving a large contribution from T2. This is called the postFixed type of the brachial plexus.

* Stages of the plexus: the plexus consists of roots, trunks, divisions, cords & branches as follows:

- (1) Stage of roots: these are the ant-1^{ry} rami of C5, 6, 7, 8 & T1
- (2) Trunks: the plexus has 3 trunks (upper, middle & lower), formed as follows:
 - (a) the upper trunk is formed by the union of the C5 & C6 roots.
 - (b) middle trunk " " " the root of C7 alone.
 - (c) lower " " " the union of the roots of C8 & T1.
- (3) divisions: each trunk divides into 2: ant-division & post-division.
- (4) Cords: the plexus consists of 3 cords which are formed as follows:
 - (a) post-cord: formed by the union of the post-divisions of the 3 trunks, thus it contains fibres from C5, 6, 7, 8 & T1.
 - (b) lat. cord: formed by the union of the ant-divisions of the upper & middle trunks. It contains fibres from C5, 6, 7.
 - (c) med. cord: formed by the ant-division of the lower trunk only it contains fibres from C8 & T1.
- (5) Branches: - the post-cord gives 5 branches.
 - the med-cord gives 5 branches.
 - the lat. cord gives 3 branches.

N.B: - the roots of the plexus give 2 branches to the u.L. $\leftarrow \begin{matrix} \text{n. to rhomboids (C5)} \\ \text{n. to serratus ant (C5, 6, 7)} \end{matrix}$
 - the upper trunk gives 2 branches: $\leftarrow \begin{matrix} \text{n. to subclavius} \\ \text{supra scapular n.} \end{matrix} \} \text{C5, 6}$

lie in the upper part of the post. Δ of the neck between scalenus ant. & scalenus medius mm.

TRUNKS

lie in the lower part of the post. Δ of the neck.

DIVISIONS

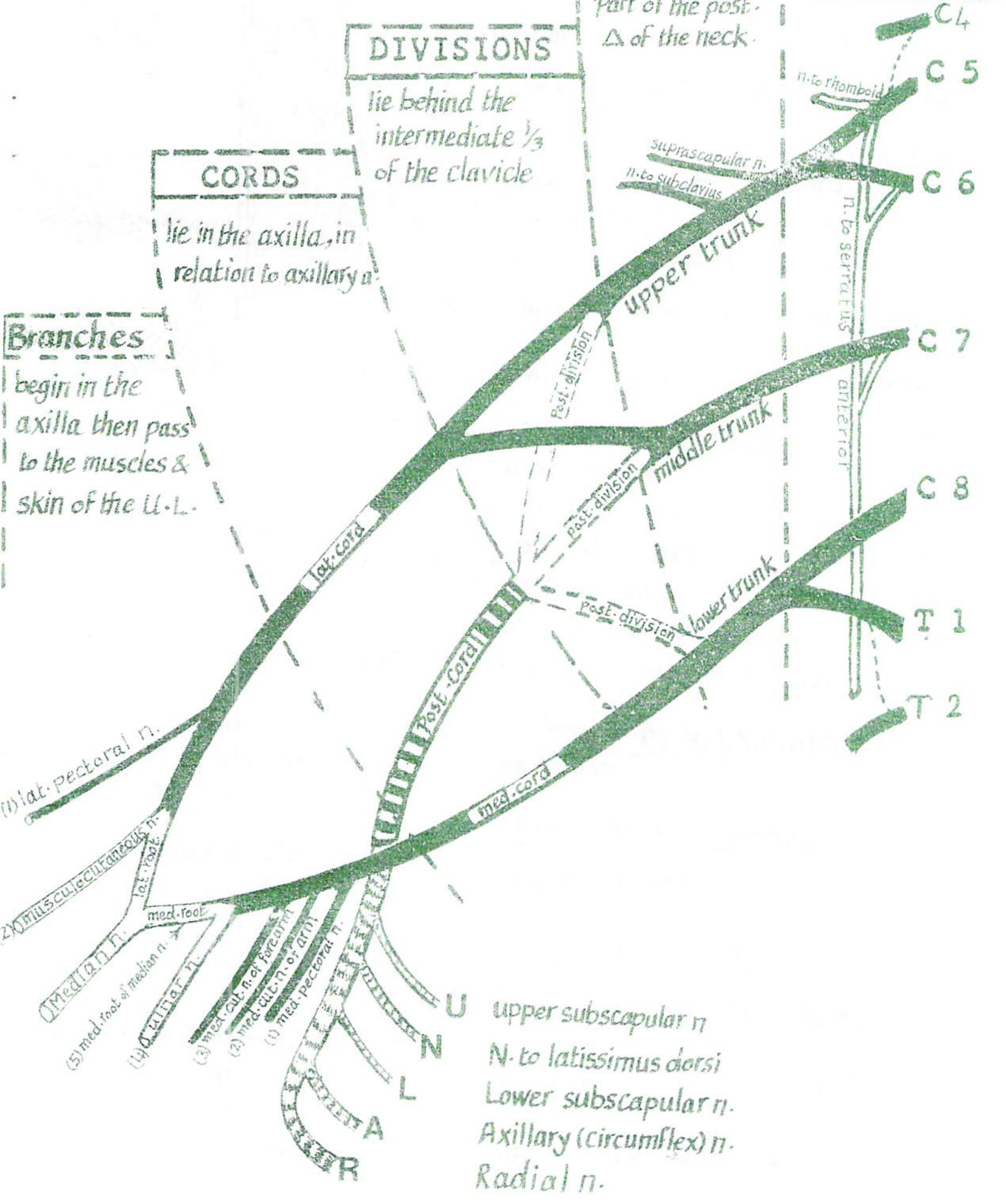
lie behind the intermediate $\frac{1}{3}$ of the clavicle

CORDS

lie in the axilla, in relation to axillary a.

Branches

begin in the axilla then pass to the muscles & skin of the U.L.



- U upper subscapular n
- N N. to latissimus dorsi
- L Lower subscapular n.
- A Axillary (circumflex) n.
- R Radial n.

* Beginning : the Br. plexus begins in the post. Δ of the neck at the lat. border of scalenus ant. muscle.

* Termination : in the axilla, at the lower border of pectoralis minor m. where the cords give their branches which supply U.L.

* Course & relations of the Br. Plexus:

(1) the roots : lie in the upper part of the post. triangle of the neck between scalenus ant. & scalenus medius mm.

(2) the trunks : lie in the lower part of post. Δ of neck.

(3) " divisions : lie behind the middle $\frac{1}{3}$ of the clavicle.

(4) " Cords : lie in the axilla, in relation to axillary a. as follows :

(a) relation of the cords to the 1st part of axillary a. :

- the med. cord lies behind the artery.
- the lat. & post. cords lie lat. to the artery.

(b) relations of the cords to the 2nd part of axillary artery :

- the medial cord lies medial to the artery.
- the lateral cord lies lateral to the artery.
- the posterior cord lies posterior to the artery.

(5) the Branches of the cords : start at the lower border of pectoralis minor muscle & are related to the 3rd part of axillary a. as follows :

- the branches of the med. cord
 med. cutaneous n. of the arm
 " " " " Forearm
 " root of median n. & ulnar n.

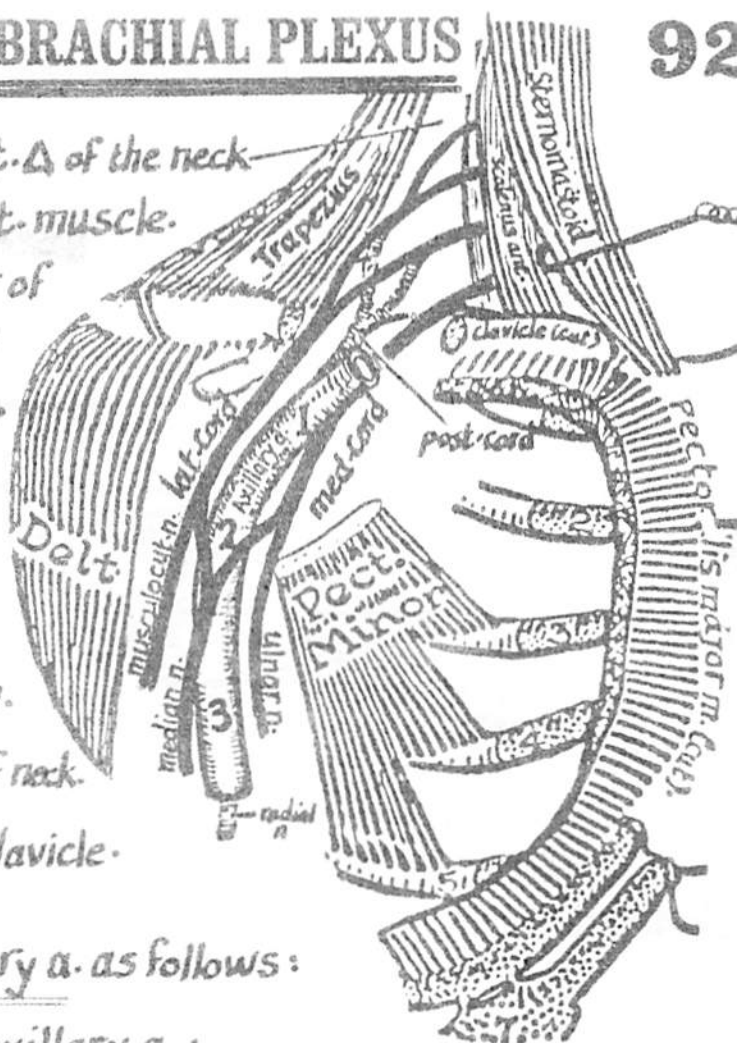
lie med. to the 3rd part of axillary a.

- the branches of the lat. cord :
 musculocutaneous n.
 lat. root of median n.

lie lat. to the 3rd part of the axillary a.

- the branches of the posterior cord
 upper & lower subscapular nerves
 n. to latissimus dorsi
 axillary n.
 radial n.

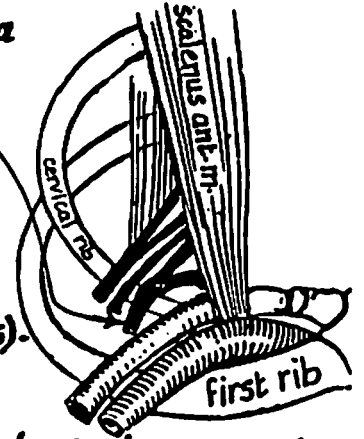
lie post. to the 3rd part of axillary a.



INJURY OF THE BRACHIAL PLEXUS 93

* Causes:

- (1) Birth injuries: excessive traction on the upper limb during difficult labour.
- (2) Direct trauma: from gunshot wounds or rarely from fracture of the clavicle.
- (3) Falls from fast moving vehicles (e.g. motor cycles): shoulder & neck are forced apart.
- (4) Cervical rib: abnormal rib attached to the last cervical vertebra may compress the lower trunk of the br. plexus



* Effects: depends on the site & degree of the injury:

1- Complete avulsion of all roots of br. plexus: leads to:

- (a) Motor affection: paralysis of all muscles of U.L. (except trapezius).
- (b) Sensory: loss of sensation of all skin of U.L. except:
 - (1) skin over upper $\frac{1}{2}$ of deltoid (supplied by supraclavicular nerves).
 - (2) " of axilla & upper part of med. side of arm (supplied by intercostobrachia)

2- Injury to the upper trunk (C5,6): (Erb's Paralysis):

(a) Motor affection: paralysis of all muscles supplied by C5,6 as follows:

- (1) paralysis of abductor muscles of arm (supraspinatus & deltoid): leads to adduction of arm.
- (2) " " the lat. rotator " " (infraspinatus & teres minor): " " med. rotation " "
- (3) " " flexors & supinators of forearm (biceps, brachialis & brachioradialis) leads to extension & pronation of the forearm.

(b) Deformity: the U.L. the porter's or policeman's tip position.

(c) Sensory loss: loss of sensation over the lower $\frac{1}{2}$ of deltoid & lat. side of forearm.

N.B.: the upper trunk of the Br. plexus is called **Erb's point** where 6 nn. meet:

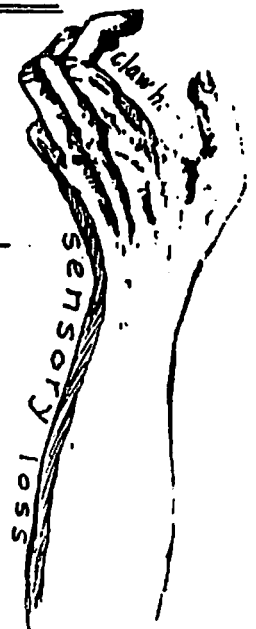
2 roots.
2 branches
2 division.

3- Injury to the lower trunk (C8,T1): (Klumpke's paralysis):

(a) Motor affection: similar to combined ulnar & median nerve injury i.e. paralysis of the flexors of the fingers & wrist (except Flex. carpi ulnaris) + " " all intrinsic muscles of the hand.

(b) Deformity: claw hand deformity due to hyperextension of the metacarpophalangeal joints & flexion of the interphalangeal joints.

(c) Sensory affection: loss of sensation along the ulnar border of the forearm & hand.

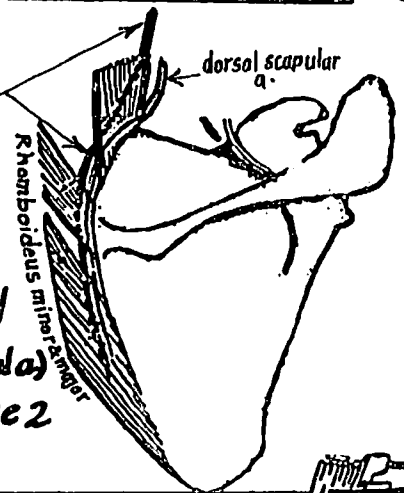


ANATOMY OF THE BRANCHES OF B. PLEXUS 94

A-- BRANCHES OF THE ROOTS

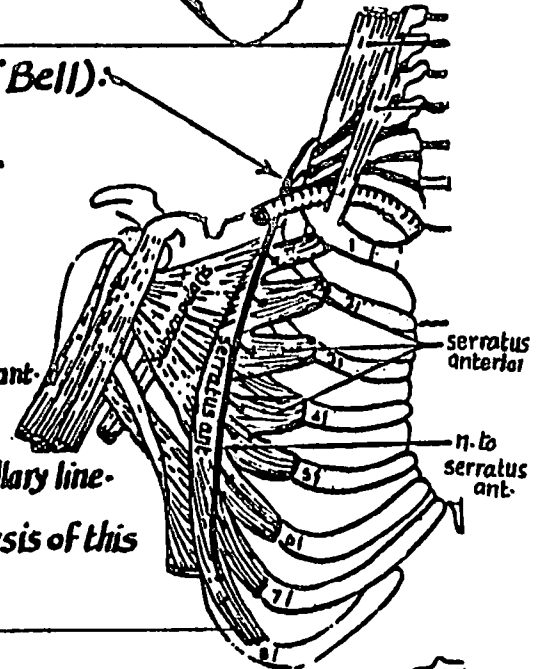
(1) Nerve to rhomboids (dorsal scapular n.):

- * Origin : from the upper most root of the B-plexus (C5)
- * Course : it descends deep to levator scapulae & the 2 rhomboids close to the med. border of the scapula accompanied by the dorsal scapular a. (deep br. of transverse cervical a.)
- * Branches : it supplies 3 muscles : the levator scapula & the 2 rhomboid muscles.



(2) Nerve to serratus ant. (long thoracic n. or nerve of Bell):

- * Origin : from the roots C5, 6, 7 of the brachial plexus.
- * Course :
 - (1) it descends behind the trunks of the Br. plexus in the neck.
 - (2) it enters the axilla by passing behind the 1st part of the axillary a. (between the artery & the 1st digitation of serratus ant.)
 - (3) it descends vertically downwards on the med. wall of the axilla (on the surface of serratus ant.) in front of the midaxillary line.
- * It supplies the serratus ant. m. & its injury leads to paralysis of this muscle resulting in winging of the scapula.



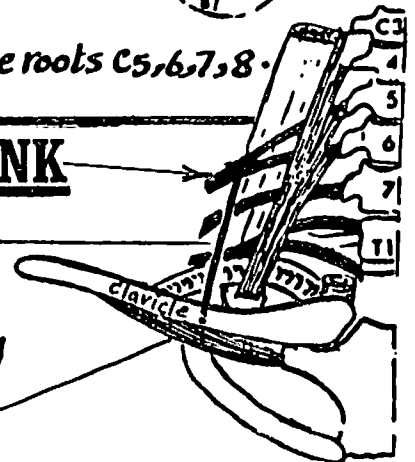
(3) A root to the phrenic n. : arises from C5 .

(4) Branches to supply scalene muscles in the neck : from the roots C5, 6, 7, 8 .

B-- BRANCHES OF THE UPPER TRUNK

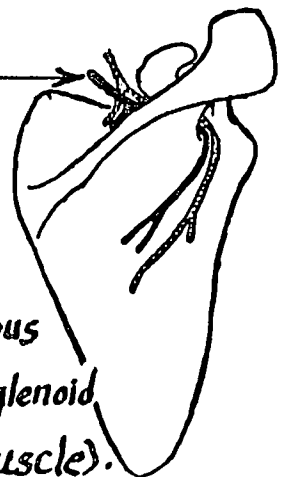
(1) Nerve to subclavius :

- arises either from the upper trunk or from the roots C5, 6.
- descends in front of the trunks of the Br. plexus then behind the clavicle & ends by supplying the subclavius muscle
- it may give a branch from C5 to join the phrenic nerve.



(2) Suprascapular nerve :

- it is a thick nerve arising from the upper trunk (C5, 6) .
- it descends downwards & laterally deep to trapezius & behind the clavicle to reach the upper border of scapula
- it passes through the suprascapular foramen to reach the supraspinous fossa (deep to supraspinatus m.), then continues through the spinoglenoid notch to reach the infraspinous fossa (deep to infraspinatus muscle).
- Branches :
 - Motor : to 2 muscles : supraspinatus & infraspinatus .
 - Articular : to 2 joints : acromioclavicular & shoulder joints



(1) Lateral Pectoral nerve (C5,6,7):

- it arises from the lat. cord then pierces the clavipectoral fascia.
- it pierces the deep surface of pectoralis major m.
- (med. to the entrance of the med. pectoral n.) to supply it.
- it also supplies pectoralis minor m. by giving a filament which joins the med. pectoral n.

(2) Medial Pectoral nerve (C8, T1):

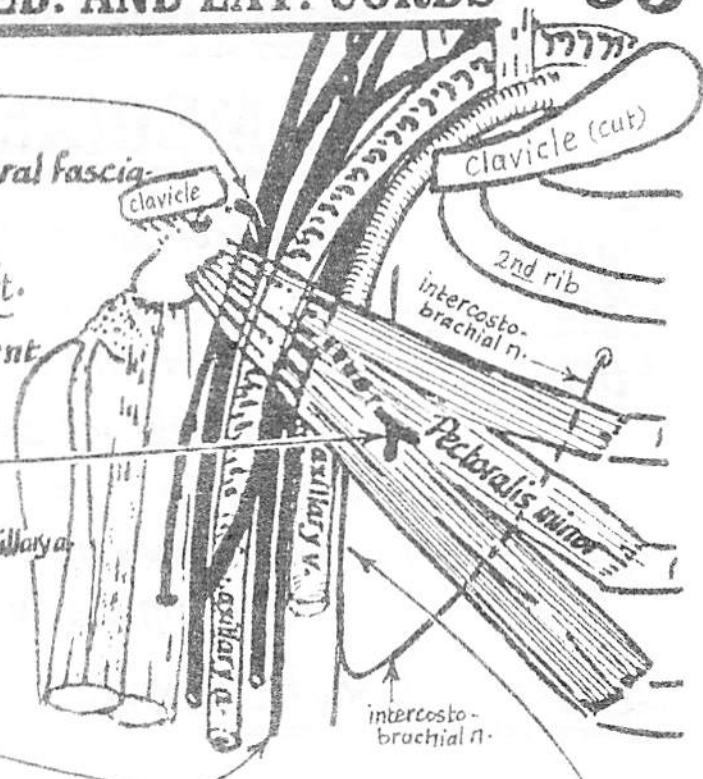
- it arises from the med. cord, med. to the 1st part of axillary a.
- it pierces pectoralis minor then enters the deep surface of pectoralis major, supplying the 2 muscles.

(3) Med. Cutaneous n. of forearm (C8, T1):

- arises from the med. cord & descends in the axilla between axillary a. & v. behind ulnar n.
- it pierces the deep fascia on the med. side of the arm, about its middle (with basilic v.)
- it then divides into 2 terminal branches (ant. & post.) which descend to the forearm as follows:
 - (a) the ant. br. : is larger & descends in front of the med. epicondyle then continues downwards along the med. side of the forearm down to the wrist.
 - (b) the post. br. descends in front of the med. epicondyle along the med. side of the basilic v. then curves to the back of the med. side of forearm down to the wrist.
- the med. cut. n. of forearm supplies: (1) skin of the front of lower part of arm.
(2) skin of the front & back of the med. side of the forearm as far as the wrist.

(4) Med. Cutaneous n. of arm (C8, T1): the smallest br. of the brachial plexus

- arises from the med. cord & descends along the med. side of axillary v. to join the intercosto-brachial nerve.
- it pierces the deep fascia at the middle of med. aspect of arm to supply the skin of lower 1/3 of med. side of the arm (the skin of the lower 2/3 is supplied by the intercosto-brachial n.).



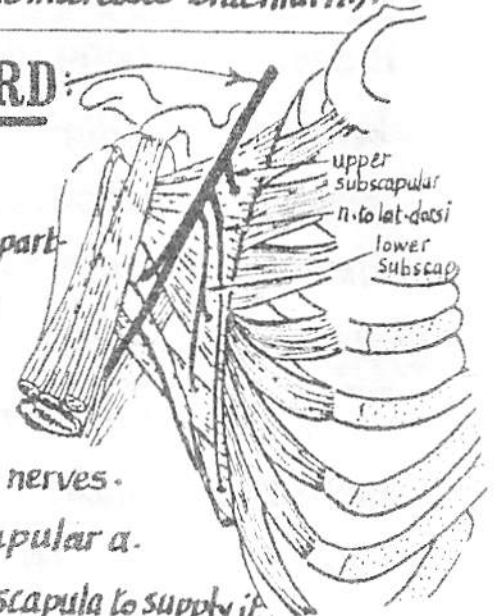
D- THE SMALL BRANCHES OF THE POST. CORD:

(1) & (2) - upper & lower subscapular nerves (C5,6):

- the upper subscapular n. sinks into subscapularis m. supplying its upper part.
- " lower " " supplies the lower part of subscapularis m. & sends a branch to supply teres major m.

(3) N. to latissimus dorsi (thoracodorsal n.): C6,7,8:

- arises from the post. cord between the origins of the 2 subscapular nerves.
- it descends along the post. axillary fold accompanying the subscapular a.
- it enters the latissimus dorsi (with its artery) at the inf. angle of the scapula to supply it.



1. MEDIAN NERVE

* Type: mixed nerve (contains motor & sensory fibres).

* Root value: C5, 6, 7, 8 & T1.

* Origin: arises in the axilla by 2 roots (lat. & med.):

(a) lat. root: from the lat. cord of the brachial plexus

(b) med root: " " med. cord " " " "

N.B.: the med. root crosses in front of the 3rd part of axillary a. to join the lat. root.

* Course & Relations:

(1) In the arm:

(a) in the upper 1/2: it descends on the lat. side of brachial a.

(b) in the middle of arm (at the insertion of coracobrachialis) it crosses in front of brachial a. from lat. to med.

(c) in the lower 1/2 of the arm: it descends on the med. side of the brachial artery.

(2) At the elbow:

(a) it enters the cubital fossa med. to the brachial a. where it lies in front of brachialis & behind the bicipital aponeurosis.

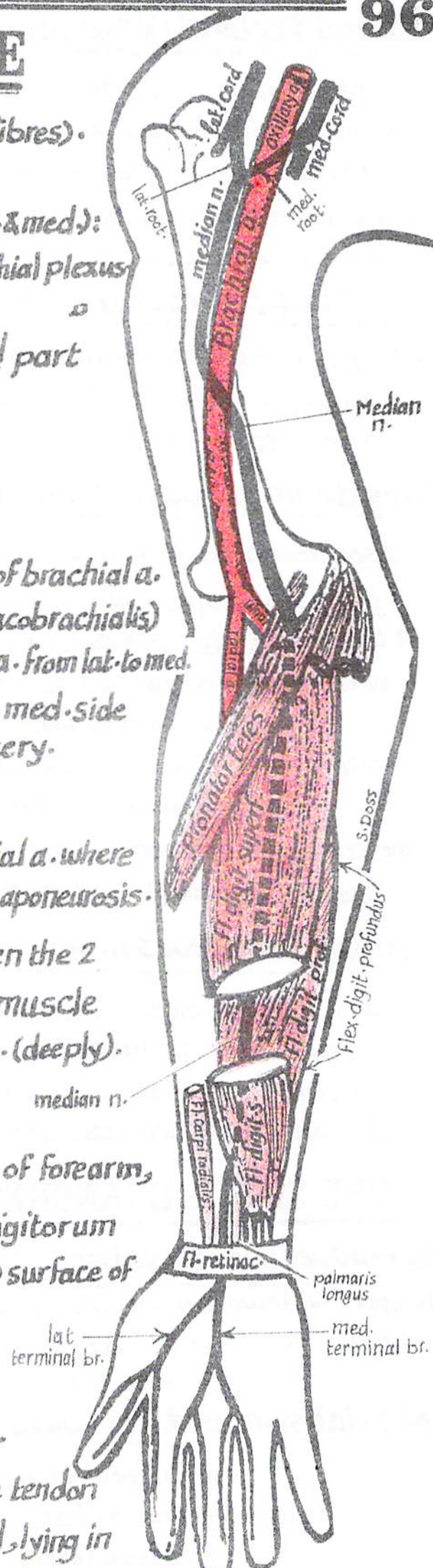
(b) it leaves the cubital fossa by passing between the 2 heads of pronator teres m. The ulnar head of this muscle separates the median n. (superficially) from ulnar a. (deeply).

(3) In the forearm:

it descends along the middle line of the front of forearm, between flexor digitorum superficialis & flexor digitorum profundus muscles, being adherent to the deep surface of flexor digitorum superficialis.

(4) At the wrist:

5 cm. above the wrist joint, the median n. emerges from under cover the lat. border of the tendon of flexor digit. superficialis to become superficial, lying in the interval between the tendons of fl. carpi radialis & palmaris longus.



(5) In the hand : the median n. enters the hand by passing through the carpal tunnel (just deep to the Flexor retinaculum).

(6) It ends : at the distal border of the Flexor retinaculum by dividing into lat. & med. terminal branches which supply the hand (see page 98)

N.B : the median n. shows a swelling at its lower end called Pseudoganglion.

BRANCHES OF MEDIAN NERVE

I- In the axilla & arm : No branches.

II- In the forearm : it gives :

(A) Muscular branches : arise from the med. side of median nerve in the cubital fossa to supply 4 muscles :

- (1) pronator teres (2) Flexor carpi radialis (3) palmaris longus
(4) Flexor digitorum superficialis

(B) Articular branches : to the elbow & sup. radioulnar joints.

(C) Anterior interosseous nerve :

- arises from median n. in the upper part of the forearm.
- it descends in front of the interosseous membrane (accompanied by ant. interosseous artery) between 2 muscles :
 - (1) Flexor pollicis longus (laterally) (2) fl. digit. profundus (medially).
- it ends by entering the deep surface of pronator quadratus m.
- it gives the following branches :

(1) Muscular branches to $2\frac{1}{2}$ muscles — Flexor pollicis longus.
— pronator quadratus.
— lat. $\frac{1}{2}$ of fl. digit. profundus.

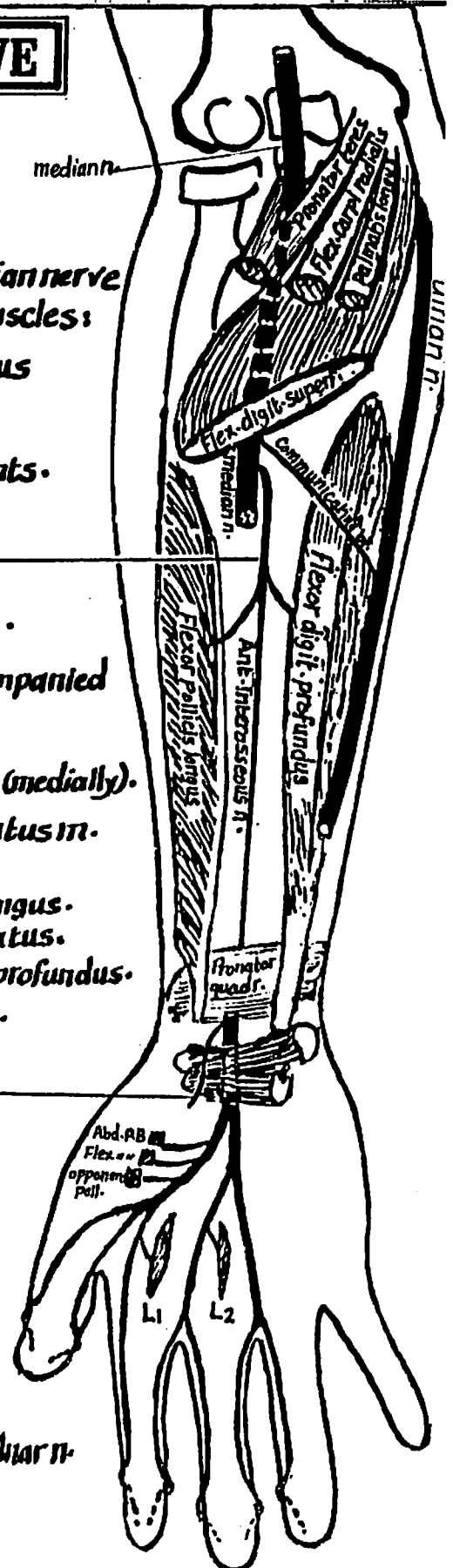
(2) Articular branches : to the wrist & inf. radioulnar joints.

(D) Palmar cutaneous branch :

- arises from median n. 1 inch above the wrist.
- pierces the deep fascia then descends superficial to the flexor retinaculum (outside the carpal tunnel).
- it supplies the skin of the lat. $\frac{2}{3}$ of the palm.

(E) Communicating br. with the ulnar n. :

- arises in the upper part of the forearm & passes downwards & medially on fl. digit. profundus to join the ulnar n.
- it carries fibres from C7 to the ulnar n.



III-Branches of the median n. in the hand:

(1) the lat. terminal branch : gives off:

(A) 3 Common palmar digital branches:

- 2 of them pass to the sides of the thumb.
- the 3rd : supplies the 1st lumbrical muscle then passes to the radial side of the index finger.

(B) Recurrent Muscular branch:

- curves upwards & laterally around the distal border of the flexor retinaculum then pierces the flexor pollicis brevis muscle.
- it supplies 3 thenar mm: (1) flexor pollicis brevis.
(2) Abductor " "
(3) Opponens pollicis.

(2) the med. terminal br. : gives 2 common palmar brs:

- the lat. br. supplies the 2nd lumbrical m. then divides to supply the adjacent sides of the index & middle fingers.
- the med. br divides to supply the adjacent sides of the middle & ring fingers.

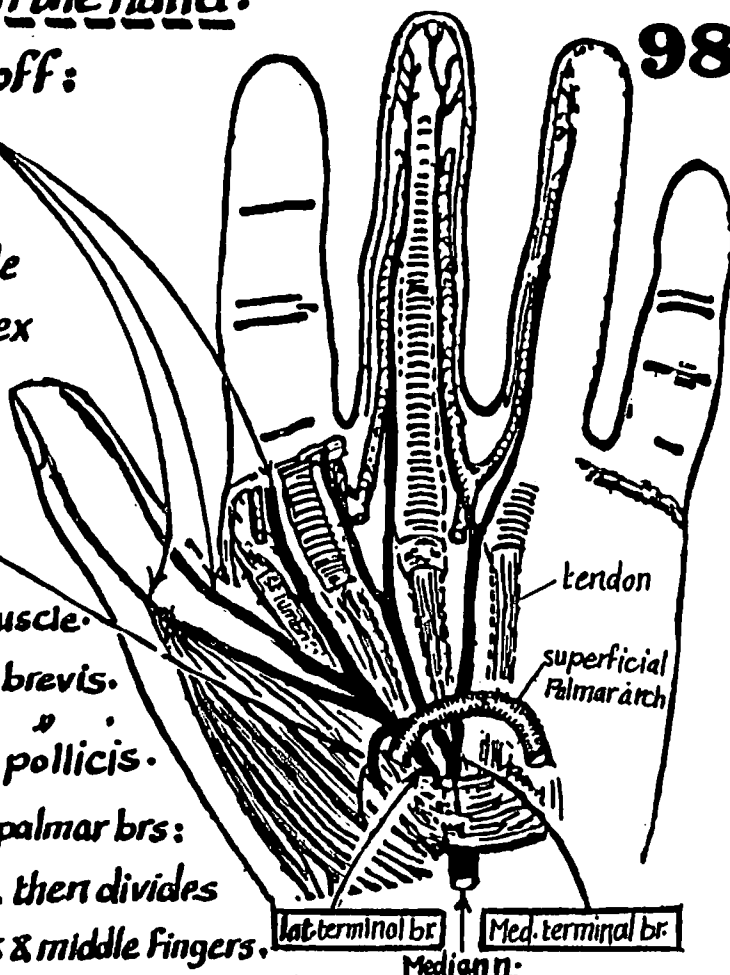
* Course & distribution of the the Common Palmar digital brs. :

- the lat. terminal division of median n. gives 3 } they pass to the lat. 3½ fingers
- the Med. " " " " " " 2 } having the following relations :

- (1) they run deep to the superficial palmar arch (& its brs.) but superficial to the long flexor tendons
- (2) at the distal part of the palm, the palmar digital nerves pass between the slips of palmar aponeurosis, in front of the deep transverse metacarpal ligaments.
- (3) they enter the fingers & continue distally on the side of the fibrous flexor sheaths.
- (4) they supply the whole palmar surfaces of the lat. 3½ fingers + the distal ½ of their dorsal surfaces.

* Summary of the branches of the median n. in the forearm & hand:

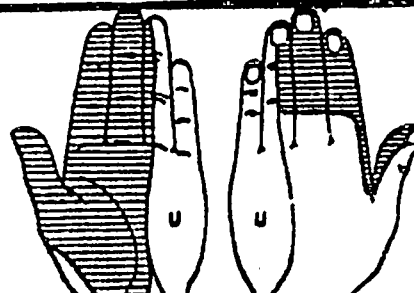
site	Motor branches (to 1½ muscles)	Sensory brs. (to lat. 2/3 of the hand)	Articular brs.	Vasomotor brs.
Forearm	- <u>Main trunk</u>: supplies 4 muscles: all superficial muscles of the front of forearm except Flex. carpi ulnaris - <u>Ant. interosseous br.</u>: supplies 2½ mm: all deep muscles of the front of forearm except the med. ½ of Flex. digit. profund.	- <u>the palmar cutaneous br.</u>: arises in the lower end of forearm & descends to the hand to supply the skin of the lat. 2/3 of the palm.	<u>Main trunk</u>: supplies elbow & supradioulnar joint - <u>ant. interosseous</u> supplies wrist & inf. radioulnar joint	to the radial & ulnar arteries
hand	- <u>lat. terminal br.</u>: supplies 4 muscles: i.e. the 1st lumbrical m. + all thenar mm (except add. poll.) - <u>Med. terminal br.</u>: supplies the 2nd lumbrical m.	- <u>lat. terminal br.</u>: gives 3 palmar digital branches: supply the skin of the lat. 3½ fingers (whole front + distal ½ of the back) - <u>Med. terminal br.</u>: gives 2 palmar digital brs.		



* Median n. injury produces

- (1) paralysis of the muscles supplied by the n. & loss of their movements.
- (2) abnormal shape (deformity) of the hand due to unopposed action of antagonist muscles
- (3) loss of sensation from the skin supplied by the nerve.

* The degree of these effects depend on the site of the injury as follows :

Site & Cause of injury	Effects (manifestations)
I-Above Elbow <u>caused by :</u> (1) penetrating wounds (2) gun shots (3) fractures of humerus	Motor Affection (1) <u>paralysis of all muscles supplied</u> : $6\frac{1}{2}$ mm. in the forearm. (enumerate them) 5 " " " " hand. (2) <u>loss of pronation of the forearm</u> due to paralysis of : (a) pronator teres (b) pronator quadratus (3) <u>weak flexion of the wrist</u>, with ulnar deviation of hand due to paralysis of all wrist flexors except flexor carpi ulnaris m. (4) <u>loss of flexion & opposition of the thumb</u> due to paralysis of flex. pollicis longus & brevis muscles + opponens pollicis. Deformity <u>Monkey (ape) hand deformity</u> : showing: (1) <u>hyper-extended thumb</u> : due to paralysis of its flexors (2) <u>adduction</u> : due to paralysis of its abductors (3) <u>flat thenar eminence</u> : due to atrophy of its mm.  Sensory loss <u>loss of sensations from :</u> - lat. 2/3 of the palm of hand. - lat. 3½ fingers anteriorly & their distal halves posteriorly. 
II-Below elbow: by (1) <u>lacerated wounds</u> causing fibrosis of pronator teres m. & compression of median n. as it passes between its 2 heads. (2) <u>cut wounds</u> at wrist.	(1) <u>Motor affection</u> : - Paralysis of the 5 hand muscles supplied by the nerve (mention). - the forearm muscles escape the injury as they are supplied at elbow. (2) <u>Deformity</u> : as in injury above elbow (Monkey hand) (3) <u>Sensory loss</u> : as in injury above elbow.

III- Inside Carpal tunnel : leads to "Carpal tunnel Syndrome"

* definition : it is compression of median n. as it passes through the carpal tunnel.

* Causes : see carpal tunnel (page 58)

* Effects : as in the injury below elbow but there is no sensory loss in the palm because the palmar cutaneous br. passes outside the carpal tunnel.

N.B: the characteristic deformity of all median n. injuries is Monkey hand

2- ULNAR NERVE

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* Type : mixed nerve (motor & sensory).

* Root value : C7, 8, T1. It receives fibres from C7 by:

- (a) a communicating br. from the lat. cord in the axilla, or,
- (b) a " " " " " median n. in the forearm.

* Origin : arises in the axilla as the largest br. of med. cord of the br. plexus, at the lower border of pectoralis minor.

* Course & Relations :

1- In the axilla & upper 1/2 of the arm:

- it descends along the med. side of 3rd part of axillary a. & proximal part of the brachial artery.
- it is related

{

posteriorly : to post. wall of axilla & long head of triceps m.

anteriorly : skin, fascia, med. cut. n. of forearm & pect. major.

2- At the middle of arm (at the insertion of coracobrachialis m.):

it pierces the med. intermuscular septum of the arm, accompanied by the sup. ulnar collateral vessels, to reach the post. compartment.

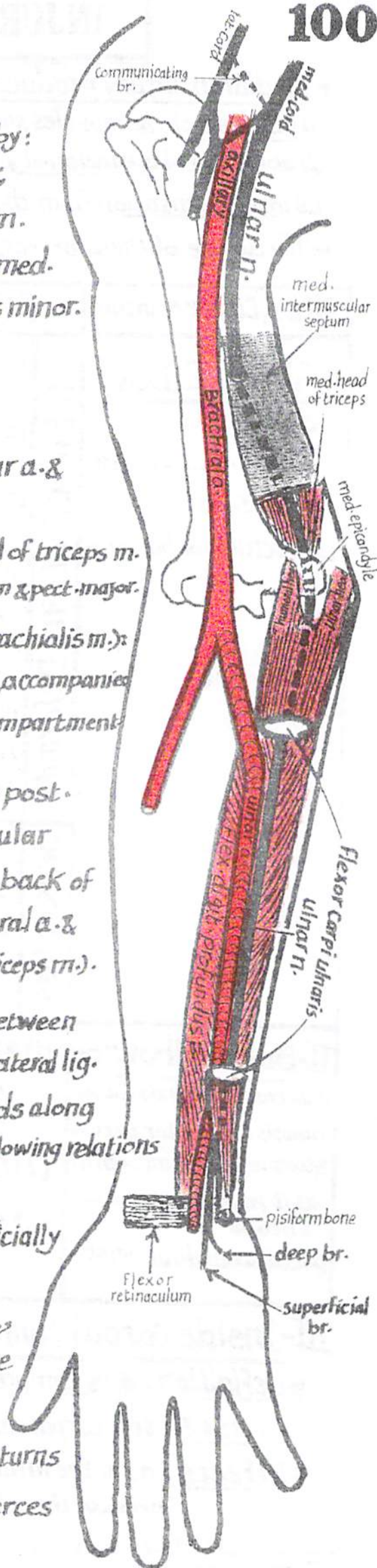
3- In the lower 1/2 of the arm : it descends in the post. compartment of the arm behind the med. intermuscular septum & in front of med. head of triceps to reach the back of the med. epicondyle accompanied by the sup. ulnar collateral a. & ulnar collateral n. (the br. from radial n. to the med. head of triceps m.).

4- At the elbow : it enters the forearm by passing between the 2 heads of flexor carpi ulnaris, lying on the ulnar collateral lig.

5- In the Forearm : it descends vertically downwards along the ulnar (medial) side of front of forearm having the following relations:

- (a) it lies on flexor digitorum profundus & covered superficially by flexor carpi ulnaris m.
- (b) the ulnar a. lies along the lat. side of the ulnar n., being separated from the nerve by an interval in the upper 1/3 & adherent to the nerve in the lower 2/3.

(6) At the wrist : 5 cm. above the wrist, the ulnar n. turns lat. to flexor carpi ulnaris (in company with ulnar a.) & pierces deep fascia to lie directly under the skin.



(7) In the hand: it enters the hand by descending in front of the med part of 101
of the flexor retinaculum lying between pisiform bone (medially) & ulnar a. (laterally)
& covered superficially by skin & palmaris brevis m.

(8) It ends: on the flexor retinaculum by dividing into superficial & deep terminal brs.

BRANCHES OF ULNAR NERVE

(I) In the axilla & arm: No branches.

(II) In the forearm: it gives:
 muscular brs. (to $1\frac{1}{2}$ muscles).
 2 cutaneous brs. (palmar & dorsal)
 articular brs.

(1) Muscular branches: arise just below the elbow joint & supply

2 muscles:
 (1) Flexor carpi ulnaris
 (2) med. $\frac{1}{2}$ of flexor digiti profundus
 (for the ring & little fingers)

(2) Cutaneous branches:

(a) palmar cutaneous branch: arises about the middle of forearm
& descends to the wrist where it crosses superficial to the flexor
retinaculum to supply the skin of the med. $\frac{1}{3}$ of the palm.

(b) dorsal cutaneous branch: arises in the lower $\frac{1}{3}$ of the forearm

& emerges from under cover of flexor carpi ulnaris & winds
downwards & backwards around the med. side of back of wrist

to supply the skin of the following areas:

- (1) the med. $\frac{1}{3}$ of the dorsum of the hand.
- (2) the dorsum of the med. $1\frac{1}{2}$ (or $2\frac{1}{2}$) fingers.

(3) Articular branches: to the elbow joint.

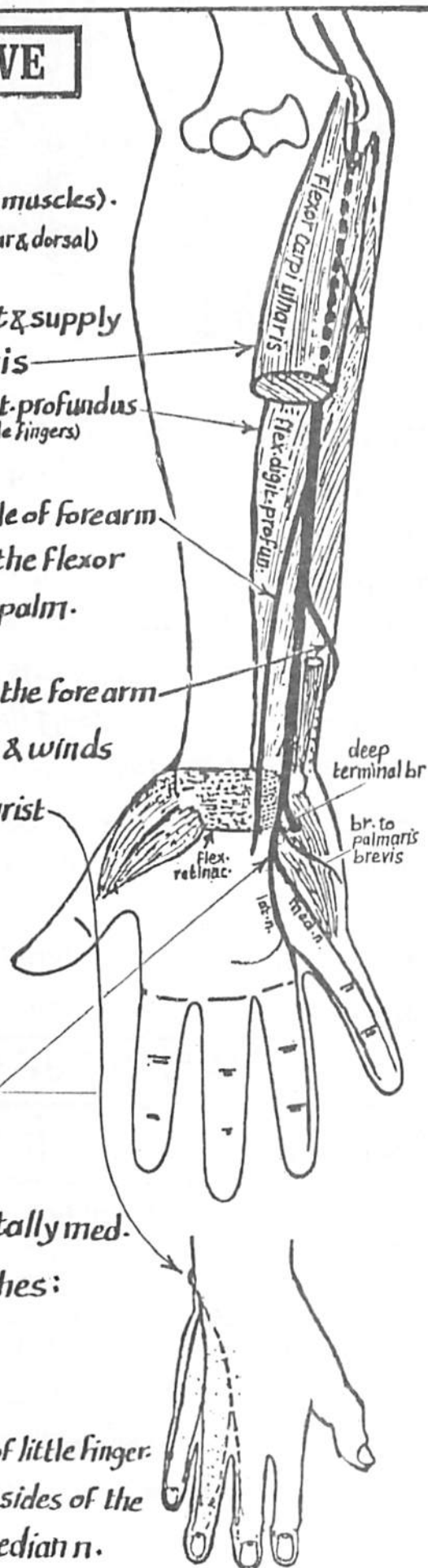
II- Branches of ulnar n. in the hand:

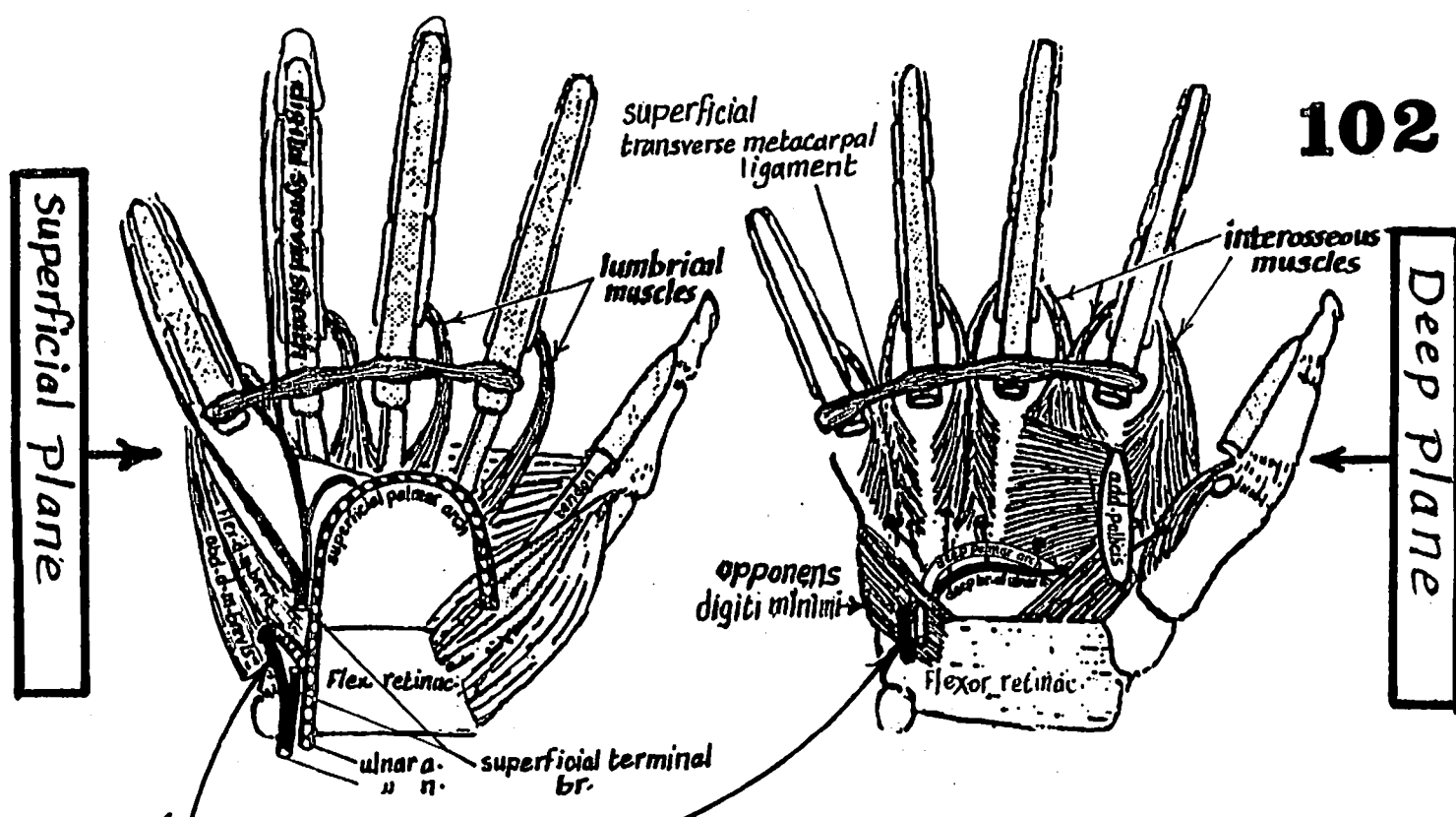
(1) the superficial terminal branch: passes distally med.
to the hook of hamate & gives off the following branches:

(1) a Muscular br. to palmaris brevis m.

(2) 2 palmar digital nerves (lat. & med.) as follows:

- the med. n. (proper palmar digital) passes to the med. side of little finger.
- the lat. n. (common " ") supplies the adjacent sides of the
ring & little fingers & communicates with a palmar br. of median n.





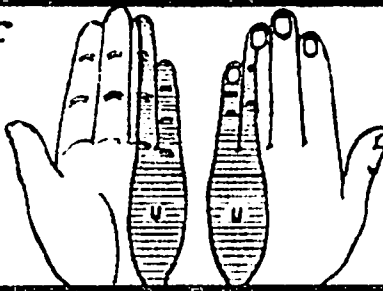
(2) the deep terminal branch:

- it is the most important br. of ulnar n. as it supplies most of the hand muscles.
- Course & relations:
 - (1) it passes backwards between the abd. digiti minimi & flexor digiti minimi brevis, accompanied by the deep branch of ulnar artery.
 - (2) then it pierces the opponens digiti minimi, curves around the hook of hamate
 - (3) it turns laterally crossing the palm deep to the flexor tendons (lying in the concavity of the deep palmar arch) to end in the adductor pollicis muscle.
- Branches:
 - (1) Motor brs. to the 3 hypothenar mm. (abductor, flexor & opponens digiti minimi). all interosseous muscles + the med 2 lumbrical muscles. adductor pollicis m. & may also supply flexor pollicis brevis.
 - (2) Articular brs. : to the wrist joint & the metacarpophalangeal joints.
 - (3) Vasomotor brs. : to the palmar arteries in the hand.

SUMMARY OF BRANCHES OF ULNAR NERVE

Branches site	Motor branches	Sensory branches	articular brs	Vasomotor brs
Forearm	to 1½ muscles only : - Flexor carpi ulnaris. - med. ½ of flex-digiti profundus	- <u>palmar cut. br.</u> : to med. ½ of palm - <u>dorsal " "</u> : to med. ½ of dorsum of hand & dorsum of med. 1½ fingers.	to elbow joint	
Hand	- <u>superficial terminal br.</u> supplies one muscle only : palmaris brevis - <u>deep terminal br.</u> supplies : • the 8 interossei + med. 2 lumbricals • the 3 hypothenar m. • add. pollicis & maybe flex. pol. brevis	- <u>superficial terminal br.</u> gives 3 palmar digital nerves to the palmar surfaces of the med. 1½ fingers.	to wrist & metacarpophalangeal joints	to palmar arteries

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Site & Causes of injury	Effects (manifestations)		
I- Above Elbow (i.e above all branches of the) nerve. Here the injury leads to complete loss of all the functions of the nerve. The injury may be caused by: (1) penetrating wounds (2) gun shots (3) fracture of med. epicondyle (4) cubitus valgus (a deformity of elbow joint causing stretch of ulnar nerve).	Motor affection	(1) paralysis of all muscles supplied $\swarrow$ $1\frac{1}{2}$ in the forearm 15 " " hand (mention them) (2) weak flexion of the wrist, with radial deviation of the hand (due to paralysis of flex. carpi ulnaris). (3) inability to flex the terminal phalanges of the med. 2 fingers (due to paralysis of med. $\frac{1}{2}$ of fl. digit. prof.) (4) inability to put the hand in the writing position (due to paralysis of interossei & med. 2 lumbricals). (5) loss of adduction of thumb (paralysis of add. pollicis).	
	Deformity	Partial "Claw hand" deformity characterised by (1) extension of the metacarpophalangeal & flexion of the interphalangeal joints due to paralysis of lumbricals & interossei N.B: the index & middle fingers are little affected because their lumbricals are intact. (2) flat hypothenar eminence (due to paralysis of its muscles)	
	Sensory loss	sensory loss from the skin of Palmar & dorsal surfaces of the med. $\frac{1}{3}$ of the hand & med. $1\frac{1}{2}$ fingers.	
II- At or above Wrist caused by cut wounds e.g cut wrist	Motor affection	limited to hand muscles only. The forearm muscles are intact because they receive supply very close to the elbow.	
	deformity	Complete "Claw hand" i.e more severe deformity than in injury above the wrist, this is called the " <u>ulnar paradox</u> " i.e against what is expected.	
	Sensory loss	loss of sensation from the palmar surfaces of the med. $1\frac{1}{2}$ fingers only. Because the palmar & dorsal cut. brs. are intact.	

3 - RADIAL NERVE

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* Type: mixed nerve (motor & sensory).

* Root Value: C5, 6, 7, 8 & T1

* Origin: arises in the axilla as the largest branch of the post-cord of the brachial plexus.

* Course & relations:

1- In the axilla & upper 1/3 of the arm:

- it descends behind the axillary a. & proximal part of the brachial a., lying in front of the post-wall of the axilla (subscapularis, teres major & latissimus dorsi muscles).
- then it passes backwards accompanied by profunda a. between the long & medial heads of triceps.

2- In the middle 1/3 of the arm:

- it descends downwards & laterally in the spiral groove on the back of the middle 1/3 of humerus between the lat. & med. heads of triceps accompanied by profunda vessels.
- at the lat. end of the spiral groove it pierces the lateral intermuscular septum to reach the ant. compartment of arm.

3- In the lower 1/3 of arm:

- it descends in the deep groove between brachialis medially & brachioradialis laterally (accompanied by ant. br. of profunda)

- 4- At elbow: the radial n. reaches the cubital fossa where it divides opposite the lat. epicondyle into 2 terminal branches:
- (a) superficial radial n. Sensory.
 - (b) deep radial (post-interosseous): Motor.

(A) Superficial radial n.

* it is sensory n. & considered as the continuation of radial n.

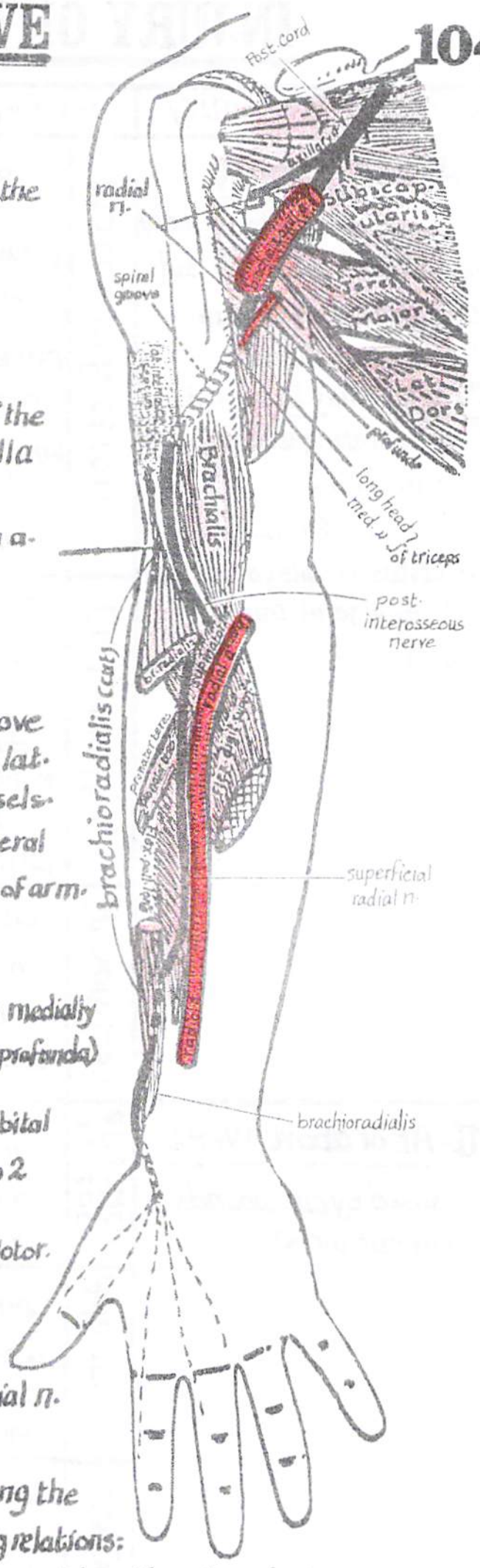
* Course & relations:

1- In the upper 2/3 of forearm: it descends along the

radial side of the front of forearm, having the following relations:

- superficially: it is covered by brachioradialis m.
- deeply: it descends on the muscles attached to radius

- (1) insertion of supinator m.
- (2) " " pronator teres.
- (3) origin " fl. digit. superficialis
- (4) " " " pollicis longus.



(2) In the lower $\frac{1}{3}$ of forearm:

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at the junction between the upper $\frac{2}{3}$ & lower $\frac{1}{3}$ of forearm, the superficial radial n. turns backwards around the lat. side of radius, emerges from under-cover of brachioradialis, pierces the deep fascia then descends superficial to the tendons of the anatomical snuff-box on the lat. part of the extensor retinaculum to reach the dorsum of the hand.

(3) on the dorsum of hand:

the superficial radial n. ends by dividing into 5 dorsal digital nerves:

2 for the thumb & 3 for the index, middle & lat. $\frac{1}{2}$ of ring finger.

* Relations of the Superficial radial n. to the radial artery:

(1) in the upper $\frac{1}{3}$ of forearm: radial n. is separated from radial a. by an interval

(2) " " middle $\frac{1}{3}$ " " : " " " related to the lat. side of radial a.

(3) " " lower $\frac{1}{3}$ " " : radial n. leaves the artery by passing backwards.

B-Posterior interosseous n.

* it is a purely motor nerve.

* origin: it arises from the radial n. in front of the lat. epicondyle.

* Course & relations:

(1) it enters the cubital fossa & pierces the supinator muscle.

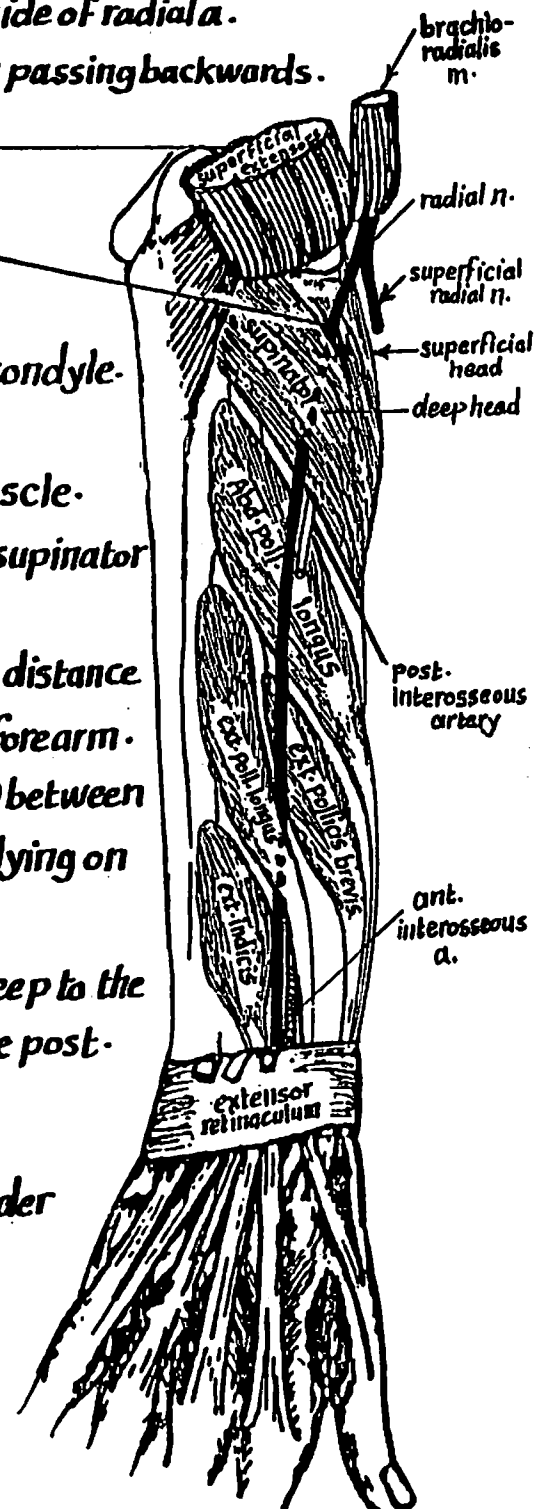
(2) it winds backwards lateral to the radius, within the supinator (between its superficial & deep parts).

(3) it emerges from the post. surface of supinator a short distance above its lower border to reach the upper part of back of forearm.

(4) it descends (accompanied by post. interosseous vessels) between the superficial & deep groups of the extensor muscles, lying on abductor pollicis longus & extensor pollicis brevis.

(5) it leaves the post. interosseous vessels by passing deep to the ext. pollicis longus to join the ant. interosseous a. on the post. surface of the interosseous membrane.

(6) Finally, it passes through the 4th compartment under the extensor retinaculum (deep to ext. digitorum & ext. indicis) to reach the back of the wrist where it ends in an enlargement.



(A) Branches of the main trunk:

3 cutaneous brs.
motor brs. to 5 m

I- Branches in the axilla & upper arm:

- (1) a branch to the long head of triceps
- (2) a branch to the medial head of triceps: it is a long br. which runs alongside ulnar nerve & is called the ulnar collateral n.
- (3) post. cutaneous n. of arm: arises high up in the axilla
- it pierces the deep fascia below the post axillary fold
- it supplies the skin of back of arm (from deltoid tuberosity to elbow).

II- Branches in the Spiral groove:

- (1) a branch to the lat. head of triceps.
- (2) " " " " med. head of triceps (a 2nd br. to the muscle):
it is a long br. which descends through the substance of the med. head to end in the anconeus muscle.
- (3) lower lat. cut. n. of arm: it pierces the lat. head of triceps just below the deltoid tuberosity to supply the skin of the lat. aspect of arm from the deltoid tuberosity down to the elbow.
- (4) Post. cutaneous nerve of forearm:
it pierces the lat. head of triceps & descends on the lat. side of the arm then passes behind the lat. epicondyle to enter the back of arm. It supplies the skin of back of forearm from the elbow down to the wrist.

III- Branches in the lower 1/3 of arm

- (1) a branch to the lateral part of brachialis m.
- (2) " " " " brachioradialis muscle.
- (3) " " " " ext. Carpi radialis longus m.

(B) Branches of post-Interosseous n.: all are motor (to 9 muscles):

I- Branches before piercing the supinator m.:

- 1- a br. to ext. carpi radialis brev.
- 2- a br. to supinator m.

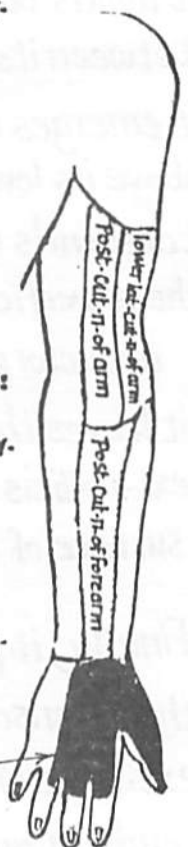
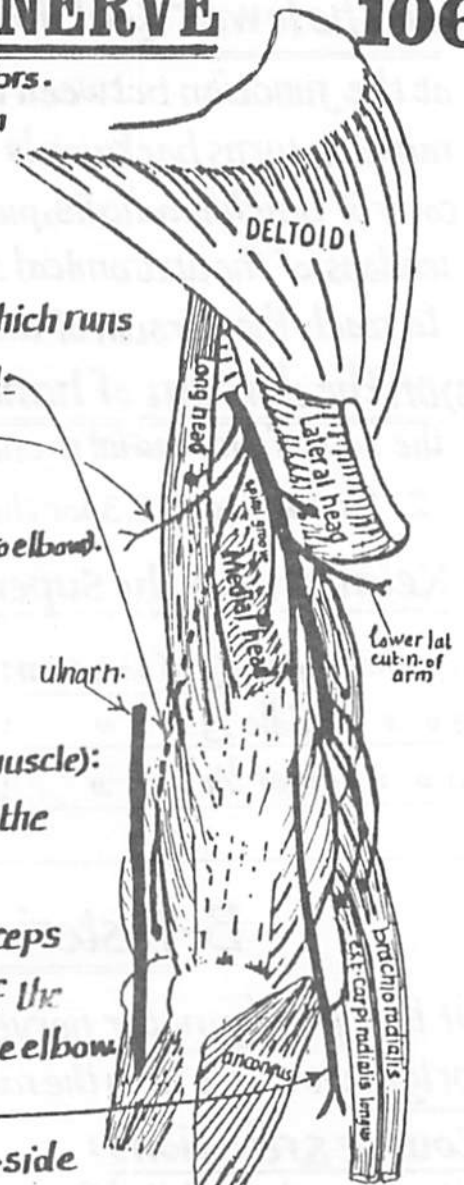
II- Branches after emerging from supinator: to 7 muscles:

- (1) extensor digitorum (2) extensor digiti minimi (3) ext. Carpi ulnaris
- (4) abductor pollicis longus (5) ext. poll. brevis (6) ext. poll. longus (7) ext. indices

(C) Branches of the Superficial radial n.: all are sensory:

it divides into 5 dorsal digital nerves which supply the skin of:

- (1) lat. 2/3 of the dorsum of hand.
- (2) dorsum of the lat. 3 1/2 fingers up to their middle (except the thumb: up to the nail).

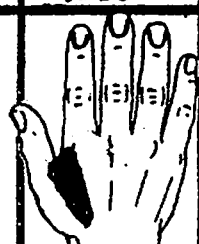


Summary of the branches of radial n.

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Main trunk of radial n. gives motor & sensory branches	post. interosseous n. gives motor branches only	Superficial radial n. gives sensory brs. only
(A) Motor brs. to 5 muscles (TABEE) 1- Triceps 2- Anconeus 3- Brachialis (lat. part) 4- Extensor carpi radialis longus 5- Brachioradialis (B) Sensory branches: (1) lower lat. cut. n. of arm (2) post. cut. n. of arm (3) post. cut. n. of forearm	(A) brs. to <u>all</u> muscles of the <u>deep group</u> of the post. compartment of forearm (5) (B) branches to the muscles of the <u>superficial group</u> of the post. compartment of the forearm <u>except</u> the muscles number <u>1, 2 & 7</u> i.e 1- brachioradialis } remember 2- ext. carpi rad. long } no. 7- Anconeus m } 127	gives 5 dorsal digital terminal brs. to supply the skin of the: (1) lat. 2/3 of dorsum of hand. (2) dorsum of the lat. 3 1/2 fingers up to their middle phalanges.

INJURY OF RADIAL NERVE

Site & Cause of the injury	Motor Affection & deformity	Sensory loss
<u>(I) In Axilla & upper arm:</u> (before the origin of its branches) injury is caused by pressure on the nerve by: (1) crutch (عكاز): as in crutch palsy. (2) back of the chair as in Saturday night palsy (3) operation table palsy	Complete loss of all nerve functions: (1) paralysis of triceps m. → loss of extension of elbow (elbow drop). (2) paralysis of wrist extensors leads to: (a) loss of extension of wrist (wrist drop). (b) weak fist because intact extensors is essential to make fist. (3) Paralysis of extensors of fingers & thumb → loss of their extension (finger drop).	 limited to the cleft between the 1st & 2nd metacarpal bones due to overlap by other sensory nerves to the skin area supplied by radial n.
<u>II- In the Spiral groove:</u> (1) fracture of middle of humerus. (2) wrong intramuscular injection.	the same as in axilla but extension of elbow is intact because the long & med. heads of triceps receive n. supply in the axilla. So, motor affection is limited to: wrist drop & finger drop only.	by other sensory nerves to the skin area supplied by radial n.
<u>III- Injury of post. interosseous n.</u> caused by fracture in the upper part of radius	- No elbow drop (as triceps is intact). - No wrist drop (as ext. carpi radialis long. is intact & it can extend the wrist). - there is only loss of extension of fingers (finger drop only).	No Sensory loss
<u>IV- injury to superficial radial n.</u> by cut wounds of back of wrist	No Motor affection	as in I & II

N.B: the characteristic deformity of radial n. injury is wrist drop



4-- MUSCULOCUTANEOUS N.

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* type : mixed n. (motor & sensory).

* Root Value : C 5, 6, 7

* Origin : arises in the axilla as the largest branch of the lat. cord of brachial plexus.

* termination : it ends by becoming the lat-cut-n. of forearm.

* Course & relations:

- (1) it descends downwards & laterally, lat. to the 3rd part of axillary artery.
- (2) it leaves the axilla by piercing the coracobrachialis m. (it gives br. to supply the muscle before piercing it).
- (3) then it descends downwards & laterally between biceps & brachialis muscles (supplying both of them).
- (4) it emerges from under cover of biceps to appear on the lat. side of the arm where it pierces the deep fascia 2" above the elbow.
- (5) then it continues as the lat-cutaneous n. of forearm which descends in the superficial fascia, along the lat. border of forearm down to the ball of thumb (base of thenar eminence), accompanying the cephalic v.

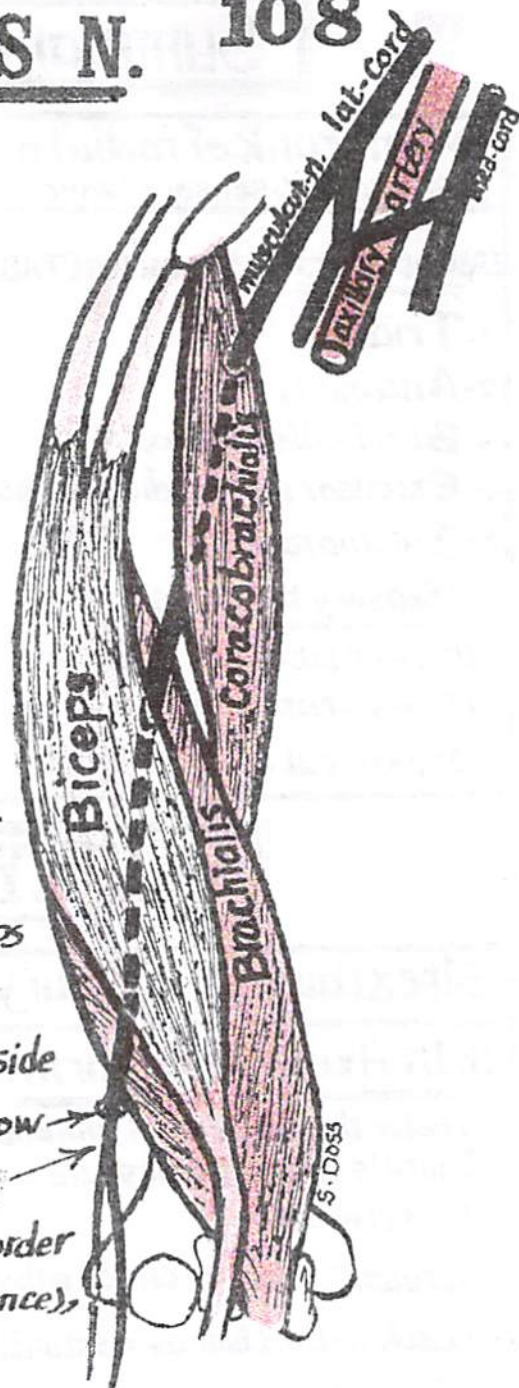
* Branches:

- (A) Muscular to 3 muscles
- (1) coracobrachialis (before piercing it).
 - (2) biceps brachii : a branch to each head.
 - (3) brachialis m.

(B) Cutaneous : the lat-cut-n. of forearm (continuation of musculocut-n.) supplies the lat. border & the lat. 1/2 of the ant. surface of forearm down to the upper part of ball of thumb.

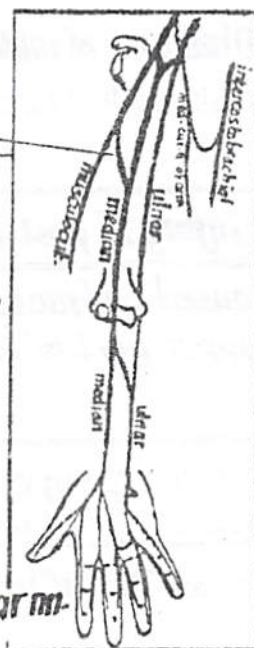
(C) Articular br. to elbow joint (through the nerve to brachialis muscle).

(d) Communicating br. to median n. in the arm :



Communications between the nerves of the U.L

- (A) In the axilla: 1- there is a communicating loop between the med-cut. n. of arm & the intercostobrachial n. (T₂).
2- connection between the lat. & med. cords of br. plexus
- (B) In the arm: a communicating br. from musculocut. n. to median n.
- (C) In the forearm: " " " " median n. to ulnar n.
- (D) In the hand: communication between palmar digital brs. of median & ulnar nn.



5--AXILLARY (CIRCUMFLEX) NERVE 109

* **Type** : mixed nerve (motor & sensory).

* **Root value** : C5, 6.

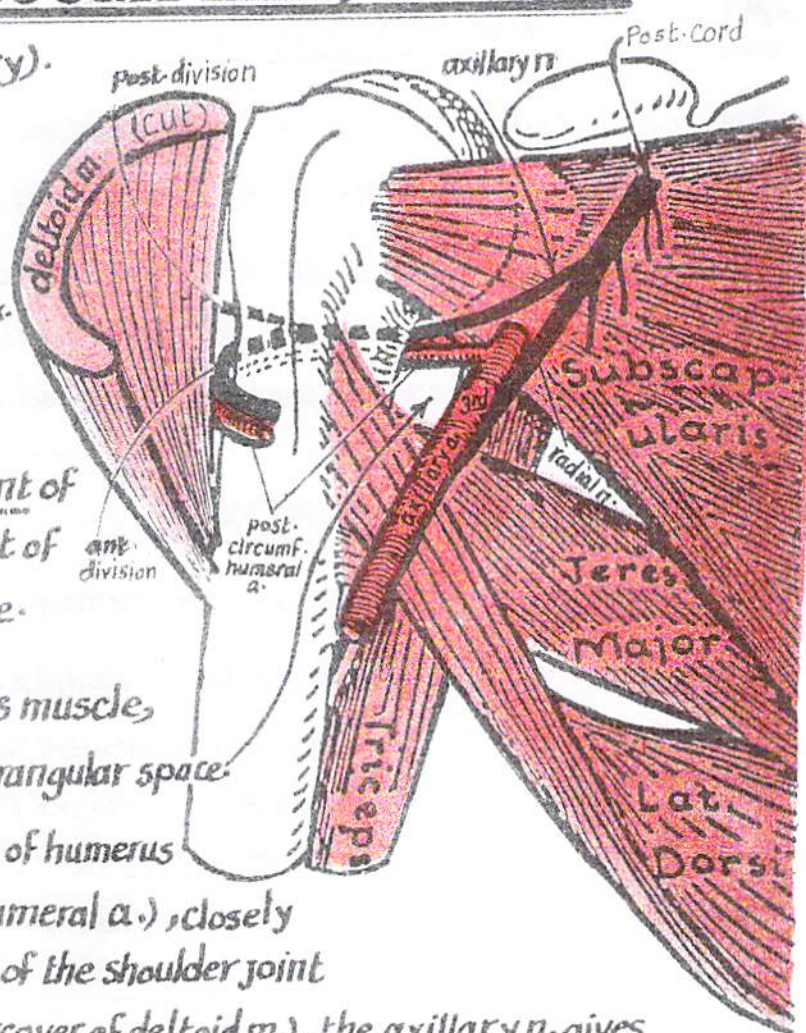
* **Origin** : arises in the axilla as the smaller of the 2 terminal branches of post-cord of br. plex.

* **Course & relations** :

- (1) It passes downwards & laterally in front of subscapularis m., behind the 3rd part of axillary artery & lat. to the radial nerve.
- (2) At the lower border of subscapularis muscle, it passes backwards through the quadrangular space.
- (3) then it turns around the surgical neck of humerus (accompanied by the post-circumflex humeral a.), closely related to the lower part of the capsule of the shoulder joint.
- (4) on the back of the surgical neck (undercover of deltoid m.), the axillary n. gives an articular br. to the shoulder joint then ends by dividing into ant. & post. divisions:
 - (A) the ant-division : continues its course forwards around the surgical neck to end near the ant.-border of deltoid (supplying it).
 - (B) the post. " : gives a br. to supply teres minor then pierces the deep fascia at the post.-border of deltoid & continues as the upper lat.-cut.-n. of arm.

* **Branches** : (muscular, cutaneous & articular) :

- (A) the main trunk : gives an articular br. to the shoulder joint (entering the joint from below).
- (B) the ant.-division : gives branches to the deltoid & cut.-brs. to the skin on its lower ant.-part.
- (C) the post.-division : supplies branches to the post.-part of deltoid & branch to teres minor.
- (d) the upper lat.-cut.-n. of arm : supplies the skin over lower part of deltoid & upper lat.-part of arm.



Injury of axillary nerve

* **Causes** : (1) fracture of the surgical neck
(2) dislocation of shoulder joint (when the head of humerus dislocates down).

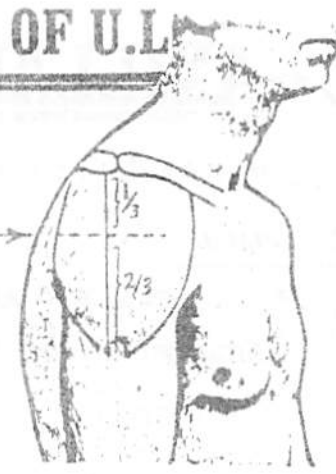
* **Effects** :

- (1) Motor affection :
 - (a) paralysis of deltoid & teres minor muscles.
 - (b) inability to abduct the shoulder from 15° to 90° (action of deltoid).
- (2) Deformity : Flat Shoulder due to atrophy of deltoid leading to excessive prominence of the acromion & the lat.-end of the clavicle.
- (3) Sensory loss : loss of skin sensation over the lower 1/2 of deltoid.

1- Axillary (circumflex) nerve:

it is represented by a horizontal line drawn across the deltoid at the junction of the upper $\frac{1}{3}$ & lower $\frac{2}{3}$ of a line extending from the tip of acromion to the insertion of the deltoid.

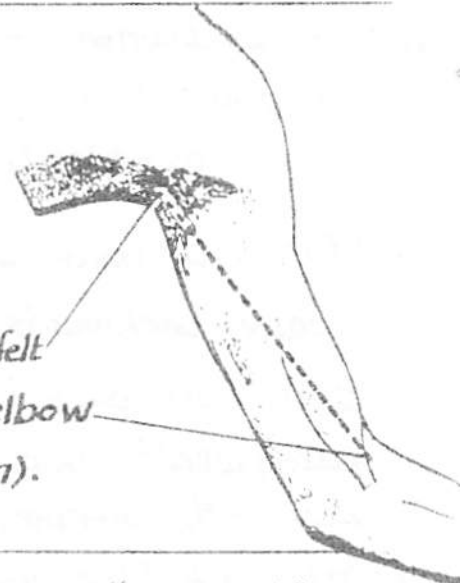
N.B: intramuscular injections should be given in the lower part of the muscle (nearer to its insertion) to avoid injury of the nerve & its accompanying a.



2- Musculo-cutaneous nerve:

it is represented by a line drawn downwards & laterally across the front of arm between the following 2 points:

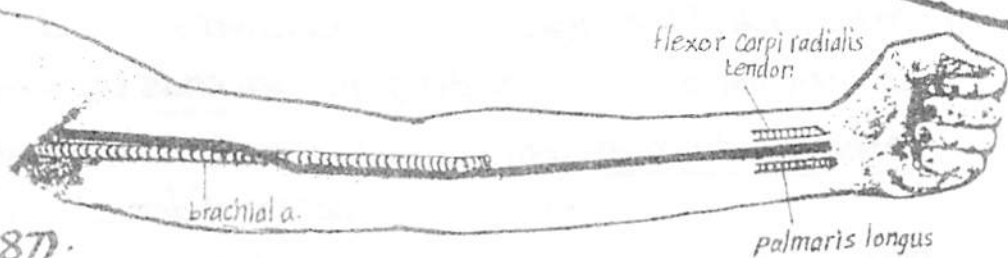
- (a) a point at the post-axillary fold (on the uppermost part of med. side of the arm) where pulsations of 3rd part of axillary a. is felt
- (b) a point lat. to the tendon of biceps, 2 cm above the bend of the elbow (here it pierces the deep fascia & continues as the lat. cut. n. of forearm).



3- Median nerve:

(A) Surface anatomy in the arm

- Mark the brachial artery (p.87).
- the nerve is then marked by a line lat. to the artery in the upper $\frac{1}{2}$ of arm & med. to the artery in the lower $\frac{1}{2}$ (the line crosses the artery in the middle of the arm).



(B) Surface anatomy in the forearm:

it is represented by a vertical line drawn in the middle of the front of forearm connecting the following 2 points:

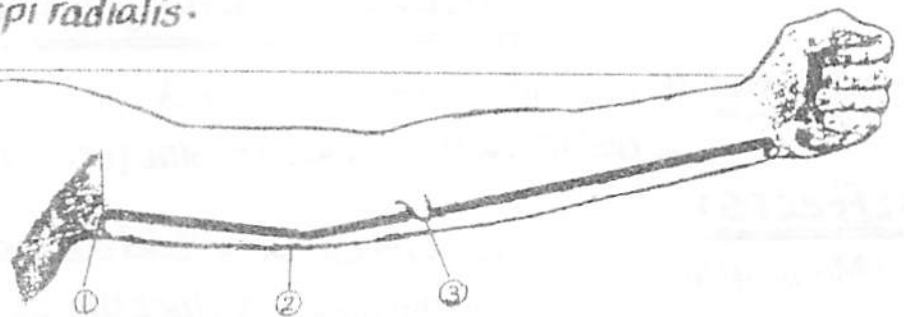
- (1) the midpoint of the cubital fossa at the bend of the elbow.
- (2) a point just above the wrist anteriorly, midway between the tendon of palmaris longus & the tendon of flexor carpi radialis.

4- Ulnar nerve:

(A) surface anatomy in the arm:

it is marked by joining 3 points:

- (1) a point at the junction of the ant. $\frac{1}{3}$ & post. $\frac{2}{3}$ of lat. wall of axilla at the lower border of teres major.
- (2) a second point at the middle of the medial border of the arm.
- (3) a third point behind the base of the med. epicondyle of the humerus.



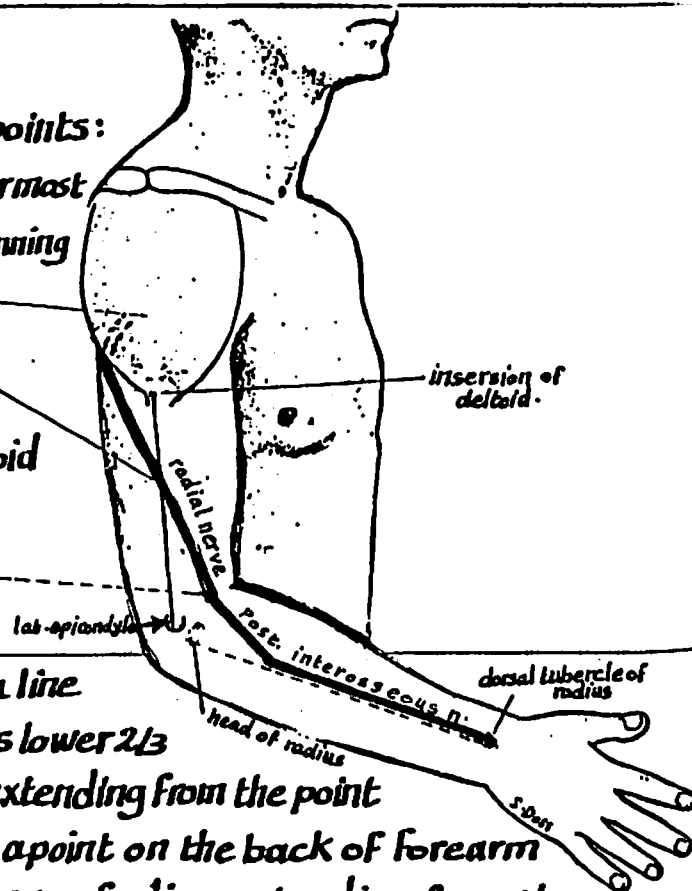
it is represented by a line connecting the following 2 points:

- (1) a point on the back of the base of the med-epicondyle.
- (2) a second point in front of wrist just lat. to the pisiform bone.

5-Radial nerve in the arm:

it is marked by a line joining the following points:

- (1) a point at the post-axillary fold (on the uppermost part of the med-side of the arm) at the beginning of brachial a. (where its pulsations are felt)
- (2) a point on the lateral side of the arm at the junction of the upper $\frac{1}{3}$ & lower $\frac{2}{3}$ of a line extending from the insertion of deltoid to the lat-epicondyle of humerus.
- (3) a 3rd point on the front of lat-epicondyle - 1 cm lat. to the biceps tendon.



6-Post-interosseous n.: represented by a line

which is oblique in its upper $\frac{1}{3}$ & vertical in its lower $\frac{2}{3}$

- (A) the upper oblique part is marked by a line extending from the point of termination of the radial n. (see above) to a point on the back of forearm at the junction of the upper $\frac{1}{3}$ & lower $\frac{2}{3}$ of a line extending from the back of head of radius to the dorsal tubercle of lower end of radius (tubercle of Lister).

DERMATOMES OF THE U.L

(SEGMENTAL N. SUPPLY OF THE SKIN OF U.L)

* Definition: a dermatome is the area of skin supplied by one spinal nerve

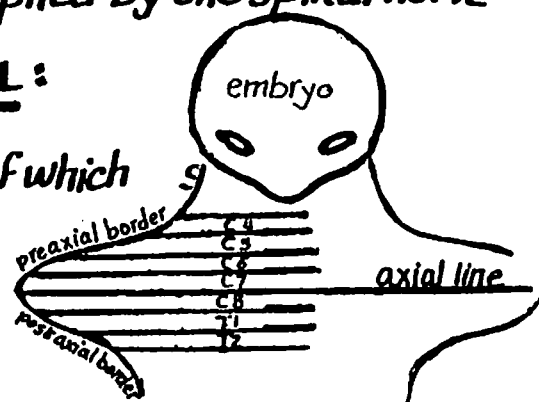
* general remarks about the dermatomes of U.L:

- (1) the U.L is formed of series of skin strips, each of which is supplied by a spinal nerve (from C₄ to T₂).

- (2) the U.L has an axial line (ventrally & dorsally) passing along the middle line of the limb, with the lat. (radial) border called the preaxial & the med. (ulnar) border called the post axial

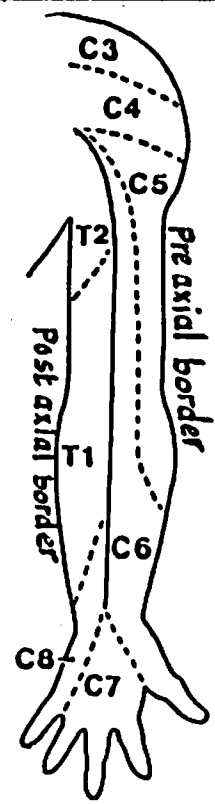
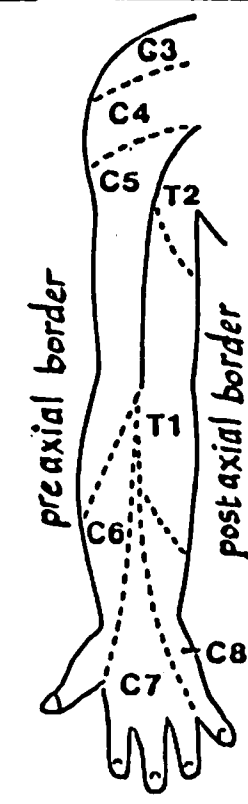
- (3) In the embryo, the dermatomes are first arranged in orderly numerical sequence:

- C₄, C₅, C₆ are arranged along the preaxial border (from proximal to distal).
- C₇ dermatome occupies the middle 3 fingers & the adjoining part of the palm.
- C₈, T₁ & T₂ are arranged along the postaxial border (from distal to proximal).

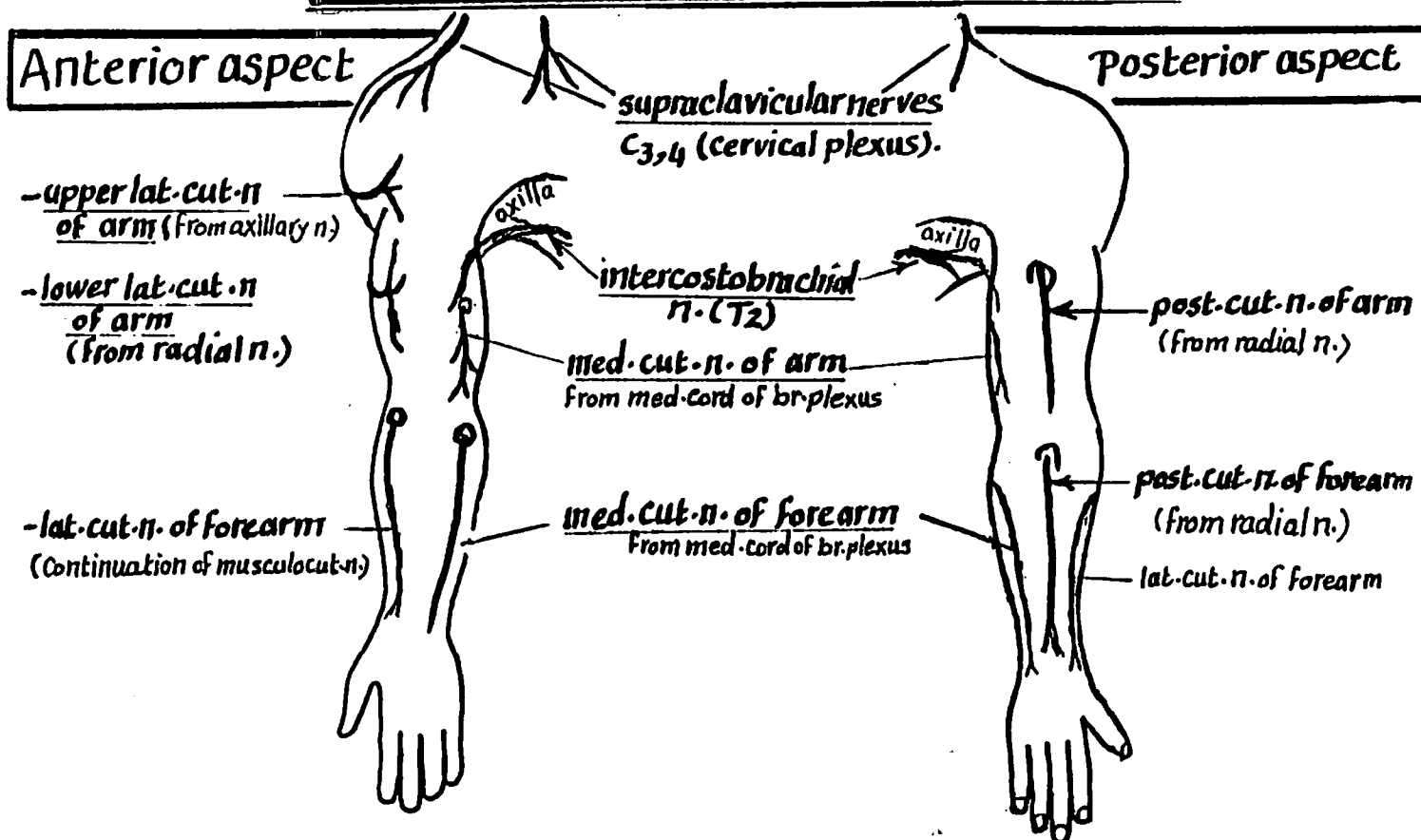


(4) As the limb grows, the central dermatomes (C_{6,7,8}) get pulled in such a way that they become represented only in the distal part of the limb & buried (disappear) proximally along the axial line of the limb (both ventrally & dorsally). 112

(5) The arrangement of the dermatomes of the adult U.L. is described as follows:

Region supplied	Root value	dermatomes of the ant.-aspect	dermatomes of the post.-aspect
Upper part of pectoral region, and skin over upper part of Deltoid	C _{3,4}		
ARM 1. Upper medial part 2. Lower medial part 3. Upper lateral part (including skin over lower part of deltoid) 4. Lower lateral part 5. Posterior aspect	T ₂ T _{1,2} C _{5,6} C _{5,6} C ₅		
FOREARM 1. Medial side 2. Lateral side 3. Posterior side	C _{8, T1} C _{5,6} C _{6,7,8}		
PALM 1. Lateral 2/3 2. Medial 1/3	C _{6,7} C ₈		
DORSUM OF HAND 1. Medial part including proximal phalanges of medial 2½ digits 2. Lateral part including proximal phalanges of lateral 2½ digits	C ₈ C _{6,7}		
DIGITS Palmar aspect, and dorsal aspect of middle and distal phalanges 1. Lateral 3½ digits 2. Medial 1½ digits	C ₇ C ₈		

CUTANEOUS INNERVATION OF THE U.L



I- Skin of the shoulder & upper part of pectoral region :

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is supplied by the med., intermediate & lateral supraclavicular nerves (C_{3,4}) which are branches of the Cervical plexus in the neck.

II- Skin of the floor of axilla : is supplied by the intercostobrachial nerve (lat. cut. br. of the 2nd intercostal n.).

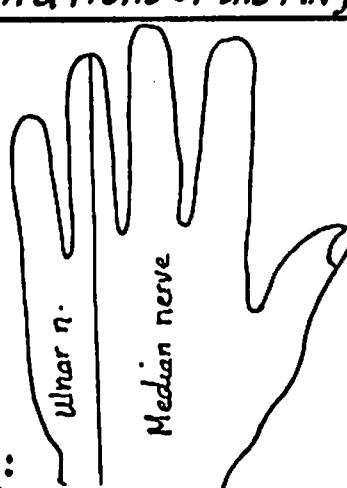
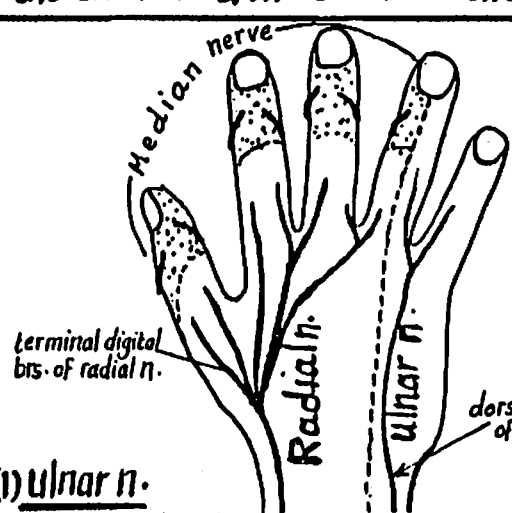
III Skin of the arm:

Post. aspect	lateral aspect	anterior aspect
supplied by the post. cut. n. of arm (br. from radial n.)	1-upper lat. cut. n. of arm (br. of axillary n.) supplies the skin over lower $\frac{1}{2}$ of deltoid 2-lower lat. cut. n. of arm (br. of radial n.) supplies the skin from deltoid tuberosity down to the elbow.	1- intercostobrachial n. (T ₂) supplies the upper med. part. 2-med. cut. n. of arm (br. of the med. cord of br. plexus) supplies the skin of the ant. & lower med. aspect

IV Skin of the forearm

Post. aspect	lateral aspect	medial aspect
supplied by the post. cut. n. of forearm (br. of radial n.)	supplied by the lat. cut. n. of forearm which is the continuation of musculocut. n.	supplied by the med. cut. n. of forearm which is a br. of the med. cord of the br. plexus.

V-Skin of the hand:

the Palm & front of the fingers	the dorsum & the back of the fingers
 (1) <u>Ulnar n. :</u> (a) its palmar cut. br. supplies the med. $\frac{1}{3}$ of palm. (b) its digital cut. brs. supply the med. $1\frac{1}{2}$ fingers. (2) <u>Median n. :</u> (a) its palmar cut. br. supplies the lat. $\frac{2}{3}$ of palm. (b) its digital brs. supply the lat. $3\frac{1}{2}$ fingers.	 (1) <u>Ulnar n. :</u> its dorsal cut. br. supplies the skin of med. $\frac{1}{3}$ of dorsum + the back of the med. $1\frac{1}{2}$ fingers. (2) <u>Median n. :</u> its digital brs. supply the skin over the distal $\frac{1}{2}$ of the back of the lat. $\frac{2}{3}$ of dorsum of hand. (3) <u>Radial n. :</u> its terminal dorsal digital brs. supply the skin over the lat. $\frac{2}{3}$ of dorsum of hand + the dorsum of the lat. $3\frac{1}{2}$ fingers up to their middle.

(1) STERNO-CLAVICULAR JOINT

* It is the only joint between the U.L. & axial skeleton.

(1) Type: synovial.

(2) Variety: modified saddle.

(3) Articulating bones:

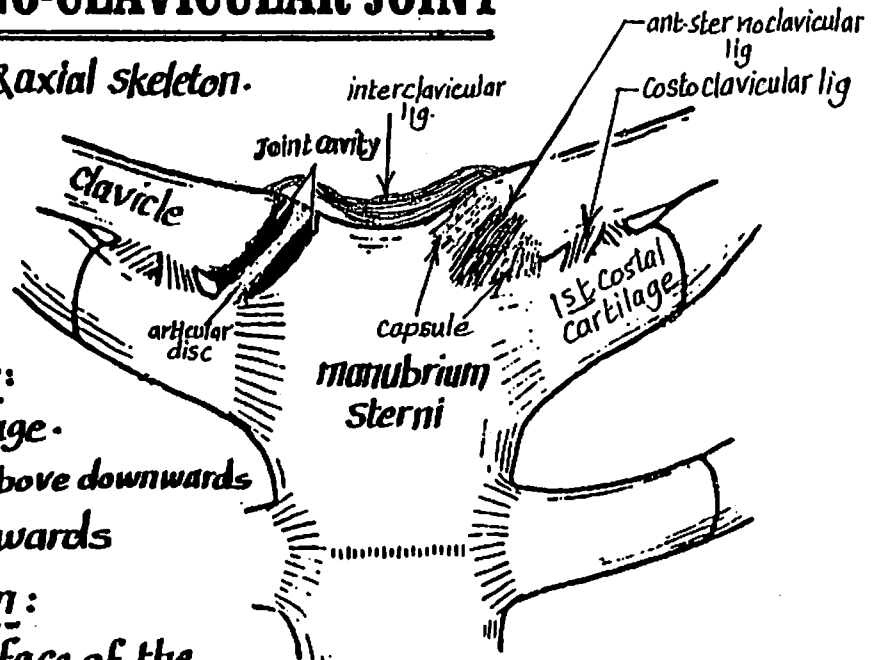
(a) medial (sternal) end of the clavicle:

- Is covered with articular Fibrocartilage.

- The articular surface is convex from above downwards & slightly concave from before backwards

(b) clavicular notch of the sternum:

is smaller than the articular surface of the clavicle & has reciprocal Convexity & Concavity.



(4) Fibrous Capsule:

- it is attached around the articular surfaces of both articulating bones.

- it is thickened anteriorly & posteriorly to form the ant. & post. sternoclavicular lig.

- it is lined internally by synovial membrane.

(5) Ligaments: the joint has the following 2 ligaments:

(a) Interclavicular ligament	(b) Costo-Clavicular ligament
- connects the med. ends of the 2 clavicles. - dips into the suprasternal notch to be attached to the manubrium sterni. - it is the only connection between the bones of the 2 upper limbs.	- it is attached above to the rough impression on the lower surface of the med. end of clavicle. - it is attached below to the 1st rib & its costal cartilage. It consists of 2 layers (ant. & post.) - it fixes the clavicle & prevents its upward dislocation.

(6) Intra Capsular structures: the Articular disc:

- it is a complete disc of Fibrocartilage which divides the joint cavity into 2 compartments (medial & lateral).

- attachments: it is attached above to the upper border of the articular surface of the clavicle & is attached below to the junction between the 1st Costal cartilage & the sternum.

- function: it is the main bond of union between the articulating bones. It also fixes the med. end of the clavicle preventing its dislocation during movements of the shoulder girdle.

7- Movements allowed :

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- (a) elevation : limited by the costoclavicular lig.
- (b) depression : limited by the interclavicular lig.
- (c) forward movement : limited by the post-sternoclavicular lig.
- (d) backward " : " " " " ant. " " " "

N.B: the movements of the sternoclavicular joint accompany the movements of the acromioclavicular joint (but in opposite direction) & both are responsible for the movements of the entire shoulder girdle (see page 116).

8- Stability:

It is very stable joint (rarely dislocated) due to the strong articular disc & ligaments.

9- Blood Supply: internal thoracic & suprascapular arteries.

10- Nerve Supply: med. supraclavicular n. (from the cervical plexus).

(2) ACROMIOCLAVICULAR JOINT

(1) Type & variety: synovial, plane.

(2) Articular Surfaces:

- (a) the oval articular facet on the lat. end of the clavicle.
- (b) the oval articular facet on the med. margin of the acromion process of the scapula.

(3) Capsule: attached around the margins of both articular surfaces.

(4) Ligaments:

(a) acromioclavicular lig.: it is the thickened upper part of the capsule.

(b) Coraco-Clavicular lig:

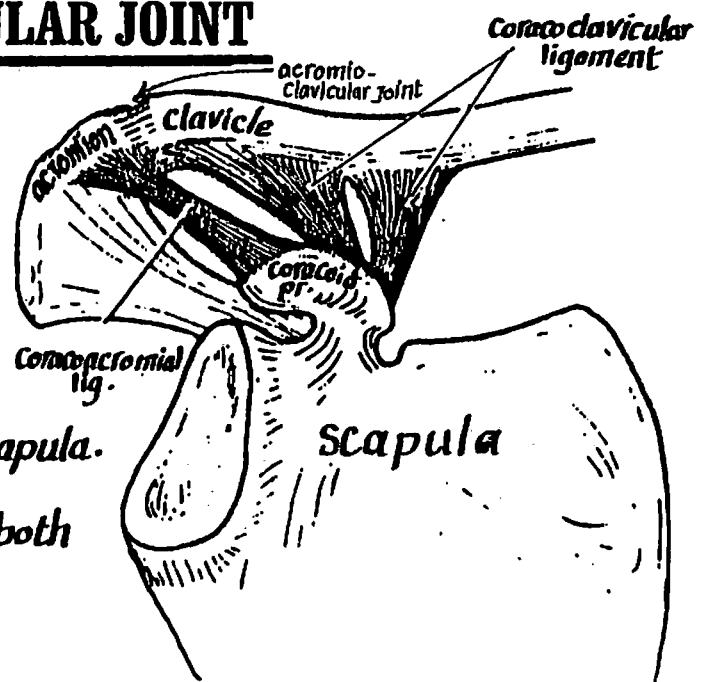
- it is a very strong fibrous lig. connecting the lat. $\frac{1}{4}$ of the clavicle to the coracoid process of the scapula.

- parts & attachments: it has 2 parts : conoid & trapezoid separated by a bursa

(1) the conoid part : is triangular in shape & forms the post. part of the ligament.

It is attached above to the conoid tubercle of the clavicle & below to the upper aspect of the bend of the coracoid process.

(2) the trapezoid part : is quadrangular in shape & forms the ant. part of the ligament. It is attached above to the trapezoid line of the clavicle & below to the upper surface of the coracoid process.



Functions of the ligament :

- (1) it suspends the scapula to the clavicle & thus transmits most of the weight (& forces) of the upper limb to the clavicle. It also prevents dislocation of the acromioclavicular joint.

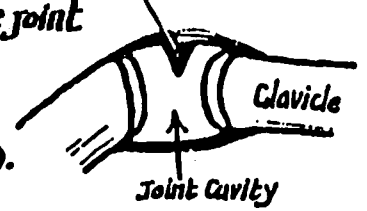
5- IntraCapsular structures : a small intraarticular disc of fibrocartilage attached to the upper part of the capsule, partially divides the joint cavity into 2 compartments.

6- Movements : slight gliding (during the movements of shoulder girdle).

7- Stability : very stable (due to the strong coracoclavicular lig.).

8- Blood Supply : suprascapular & thoracoacromial arteries.

9- Nerve Supply : lateral supraclavicular n. (from the cervical plexus).

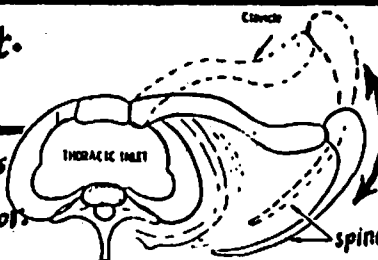


THE SHOULDER GIRDLE

* **Definition :** the shoulder girdle is the functional bony unit formed of the clavicle & scapula.

* **Movements :** the shoulder girdle moves at 2 joints (the sternoclavicular & acromioclavicular) at the same time. The main movements of the girdle are carried by the scapula as follows :

Movement	Muscles responsible for it	checked by :
Elevation of the Scapula (shrugging of shoulder)	(1) upper fibres of trapezius (2) levator scapulae	the costoclavicular ligament.
depression of the scapula (drooping of shoulder).	(1) pectoralis major (2) pectoralis minor (3) latissimus dorsi (4) it is aided by gravity	the interclavicular lig. & articular disc of the sternoclavicular joint
upward rotation of the scapula the glenoid cavity is directed upwards	(1) upper fibres of trapezius (2) lower " " " (3) lower digitations of serratus ant.	the stretch of the opposing muscles.
downward rotation of scapula the glenoid cavity is directed downwards.	(1) levator scapulae (2) rhomboideus major & minor (3) pectoralis minor	the stretch of the opposing muscles.
protraction forward movement of scapula	(1) whole serratus ant. (2) pectoralis minor	the posterior sternoclavicular lig.
Retraction backward movement of the scapula towards the verteb. column.	(1) middle fibres of trapezius (2) rhomboideus major & minor	the anterior sternoclavicular lig.



(3) THE SHOULDER JOINT

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(1) Type & variety : synovial, ball & socket.

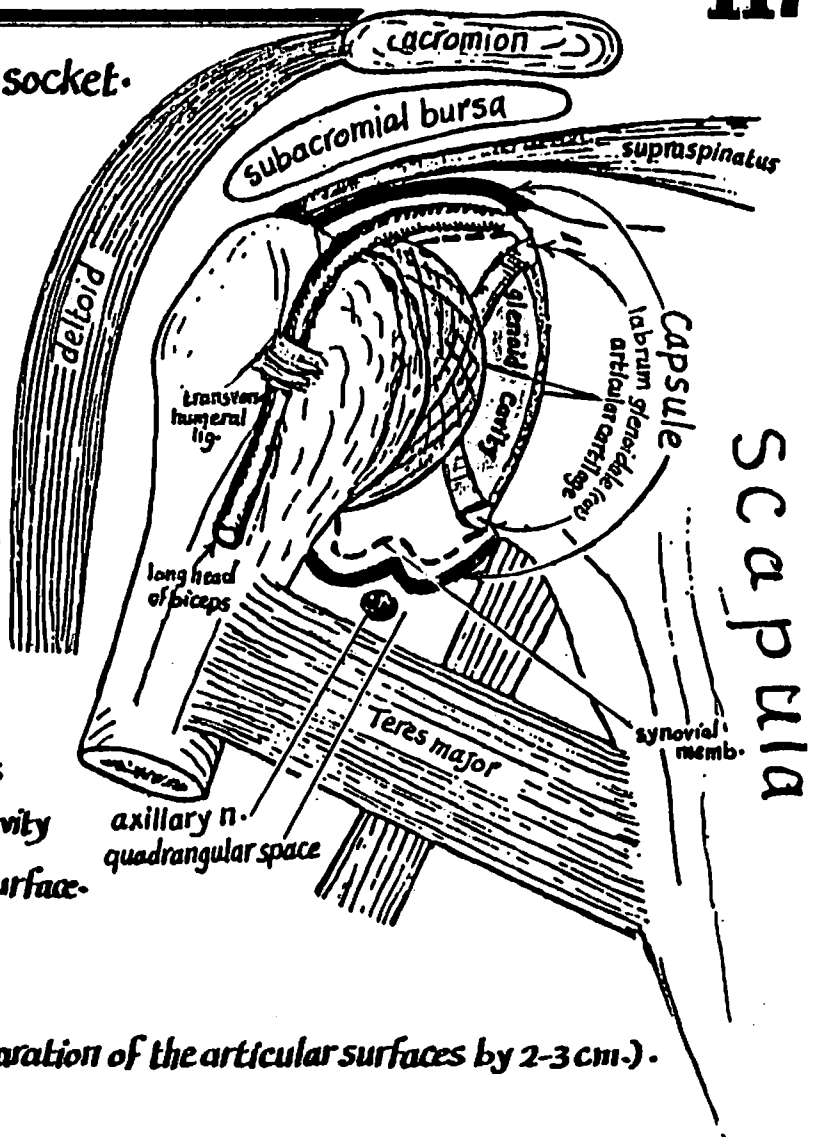
(2) Articular surfaces :

(a) head of the humerus (the ball) :

- it is less than hemisphere & covered by hyaline articular cartilage
- it is directed medially, backwards & slightly upwards.

(b) glenoid cavity of scapula (the socket) :

- it is a pear-shaped shallow cavity which is narrow above but wide below.
- it is deepened by a lip of fibrocartilage called the labrum glenoidal which is attached to the margins of the glenoid cavity forming a soft margin for the articular surface.



(3) Capsule :

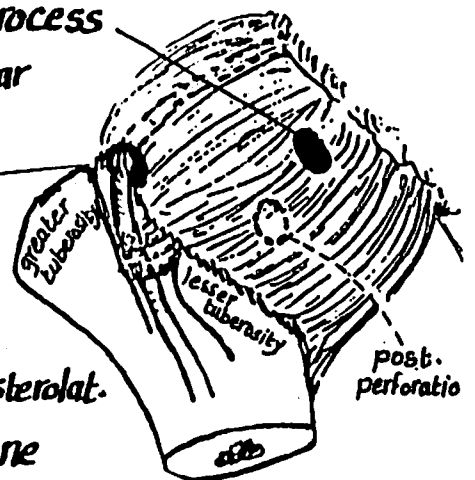
* Characters : it is thin & lax (allowing separation of the articular surfaces by 2-3 cm.).

* Attachments :

- (a) medially (scapular end) : it is attached to the circumference of the glenoid cavity just outside the labrum glenoidal (fusing with its outer surface). The supraglenoid tubercle (origin of long head of biceps) is included inside the capsule but the infraglenoid tubercle is excluded.
- (b) laterally (humeral end) : it is attached to the anatomical neck of humerus except :
 - above where it is attached to the transverse humeral lig (between the 2 humeral tuberosities)
 - below & medially where it descends for 1-2 cm. to be attached to the surgical neck.

* Openings (perforations) of the capsule :

- (1) anterior perforation : situated just below the coracoid process through it the joint cavity communicates with the subscapular bursa (deep to the tendon of subscapularis muscle)
- (2) lateral perforation : situated anterolaterally between the greater & lesser tuberosities for the passage of the tendon of long head of biceps.
- (3) posterior perforation : is occasionally present in the posterolateral part of the capsule & through which the synovial membrane protrudes forming bursa deep to the supraspinatus tendon.



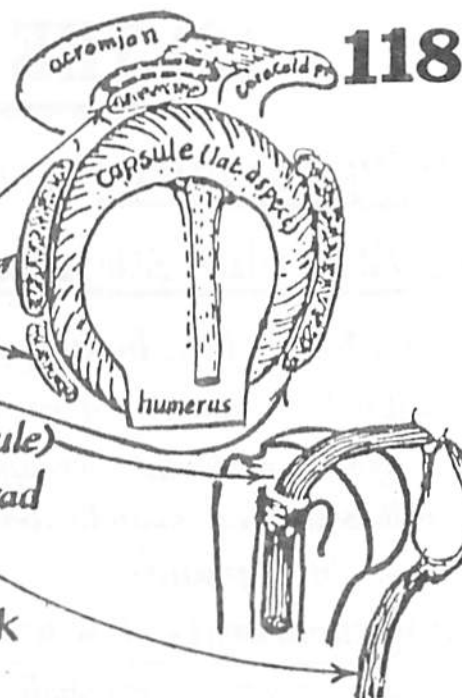
* Factors supporting the Capsule:

the tendons of the "Muscle Cuff" which surround the joint blending with the fibrous capsule & consist of

- (a) supraspinatus tendon----- (superiorly)
- (b) infraspinatus & teres minor tendons (posteriorly)
- (c) the subscapularis tendon----- (anteriorly)

the tendon of the long head of biceps (inside the capsule) supports it from above while the tendon of the long head of triceps affords less support to the capsule inferiorly

the ligaments outside the capsule (see below) are weak & provide a little support.



(4) Ligaments:

(a) coracohumeral lig.: adherent to the upper surface of the capsule

- it is attached medially to the lat. border of the root of coracoid process.

- " " " laterally to the front of the greater tuberosity of humerus.

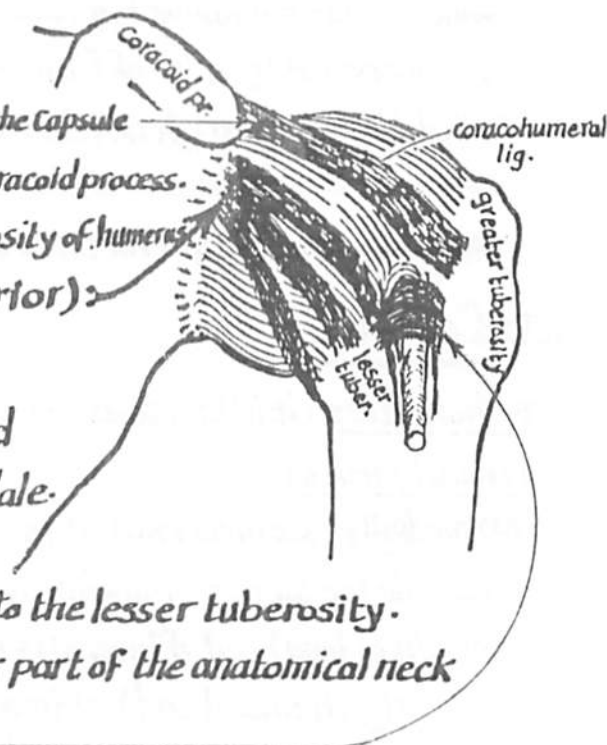
(b) glenohumeral ligaments (sup., middle & inferior):

- they are thickened parts of the front of the capsule

- medially they are attached to the upper part of the med. margin of the glenoid cavity & labrum glenoidale.

- laterally, they are attached as follow:

- the sup. & middle ligaments are attached to the lesser tuberosity.
- the inf. ligament is attached to the lower part of the anatomical neck



(c) transverse humeral lig.:

- it is a transverse band bridging over the upper part of the bicipital groove & attached between the greater & lesser tuberosities of the humerus

- it acts as a retinaculum holding the tendon of the long head of biceps in place.

(5) Intra-Capsular Structures:

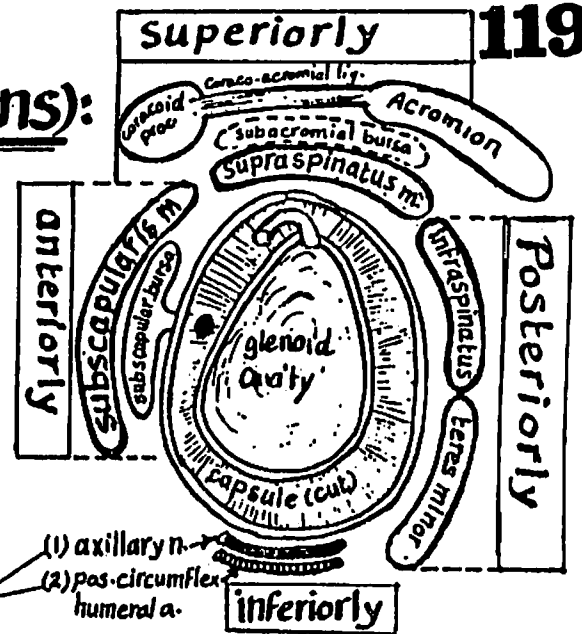
- (1) synovial membrane.
- (2) labrum glenoidale.
- (3) tendon of long head of biceps. (intracapsular extrasynovial).

* the synovial membrane:

- lines the inner surface of the capsule & is reflected on to the intracapsular part of surgical neck.
- it communicates with the subscapularis bursa through the ant-perforation of the capsule.
- it envelops the tendon of long head of biceps forming a tubular sheath which comes out of the capsule through its lateral perforation.

(6) Extra capsular Structures (Relations):

- (A) Superiorly : (1) supraspinatus m.
 (2) subacromial bursa.
 (3) Coracoacromial arch.
- (B) Anteriorly : (1) subscapular bursa.
 (2) subscapularis muscle.
- (C) Posteriorly : (1) infraspinatus muscle.
 (2) teres minor
- (D) Inferiorly : the quadrangular space containing :



(7) Bursae related to the joint :

- (a) Subscapular bursa : lies between the subscapularis tendon & the front of the capsule of shoulder joint. It usually communicates with the joint cavity.
- (b) Infraspinatus bursa : lies between the tendon of infraspinatus m. & the back of the capsule of shoulder joint. It occasionally communicates with the joint cavity.
- (c) Subacromial bursa : intervenes between coracoacromial lig & acromion (above) and the supraspinatus tendon below. It does not communicate with the joint cavity.
- (d) a subcutaneous bursa is situated between the upper surface of acromion & the skin.
- (e) a bursa may be present between the coracoid process & the capsule of the joint.

(8) Movements allowed & Muscles acting :

* General considerations :

The shoulder joint is a ball & socket synovial joint in which the stability has been sacrificed for the sake of movements.

A- Movements allowed : the joint allows a wide range of movements as : Flexion & extension, abduction & adduction, med. rotation & lat. rotation & circumduction.

Factors responsible for the wide range of movements :

- (1) Laxity of the capsule.
- (2) the large size of the head of humerus in relation to the small & shallow glenoid cavity

B- Muscles acting : general rules :

- (1) muscles arising from the clavicle & scapula and inserted into the humerus act on the shoulder joint only.

2- Muscles arising from the bones of the trunk & inserted into the humerus **120**

act on both shoulder joint & shoulder girdle

3) Muscles acting on the shoulder joint are divided into 2 groups :

(a) prime movers : which produce powerful action e.g pectoralis major, teres major, deltoid & latissimus dorsi

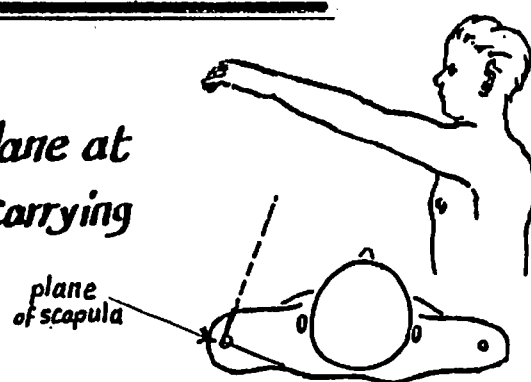
(b) stabilizing muscles e.g the muscles of the "rotator cuff" (supraspinatus, infraspinatus, teres minor & subscapularis) which stabilize the head of the humerus in the glenoid cavity during the action of the prime movers.

* Analysis of the movements of the shoulder joint:

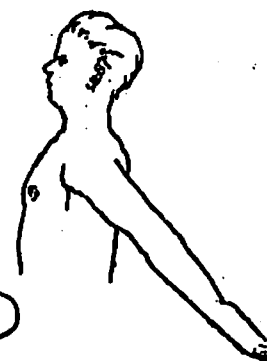
(1) Flexion:

* the humerus moves forwards & medially in a plane at right angle to the plane of the scapula, thus carrying the arm across the front of the chest.

* The muscles responsible for flexion are:



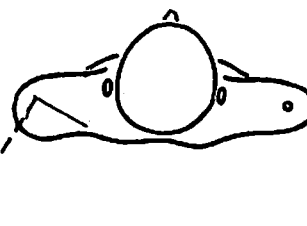
Main Flexors	Assistant Flexors
(1) Pectoralis major (clavicular head) (2) Ant. fibres of deltoid	(1) Coracobrachialis (2) long head of biceps



(2) Extension:

* the humerus moves backwards & laterally in a plane at right angle to the plane of the scapula

* the muscles responsible for extension are :



Main Extensors	Assistant extensors
(1) Post. Fibres of deltoid (2) latissimus dorsi	(1) teres major (2) Sternocostal head of pectoralis major (when fully flexed arm is extended against resistance)

(3) Abduction:

- it is the movement in which the arm is carried away from the trunk

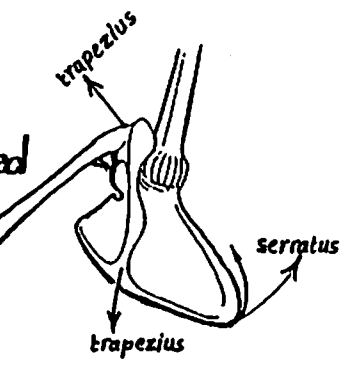
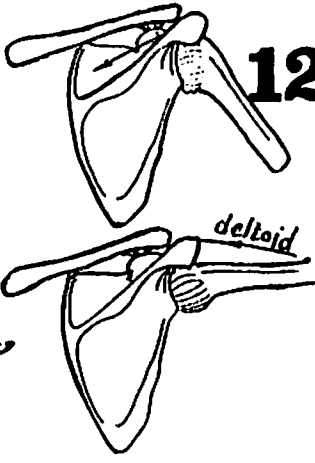
- it takes place at a plane perpendicular to that of the flexion & extension

- the range of abduction is 180° & can be divided into 3 stages as follows:

(1) Abduction from 0° to 15° is carried out by supraspinatus m.
(2) " " 15 to 90 is carried out by the middle fibres

of the deltoid. The rotator cuff muscles stabilize the head of humerus preventing it from being displaced up by the deltoid.

N.B: in the previous 2 stages, for every 15° degrees of abduction, 10 degrees occur at the shoulder joint & 5 degrees are due to movement of the scapula at the shoulder girdle



(3) Abduction from 90 to 180° : occurs wholly at the shoulder girdle where the scapula rotates upwards by the combined action of trapezius & serratus ant.

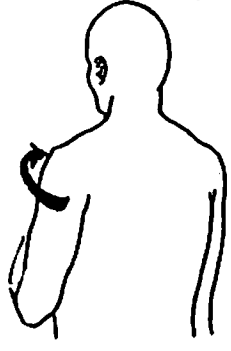
(4) Adduction :

- It is the movement in which the arm is carried towards the trunk in the same plane of abduction but in reverse direction
- the muscles responsible for adduction are :

Main adductors	Assistant adductors
(1) pectoralis major (2) latissimus dorsi (3) teres major	(1) subscapularis (2) infraspinatus (3) teres minor
i.e. muscles inserted into the bicipital groove	
i.e muscles inserted into the lesser & greater tuberosities of humerus	

(5) Medial rotation :

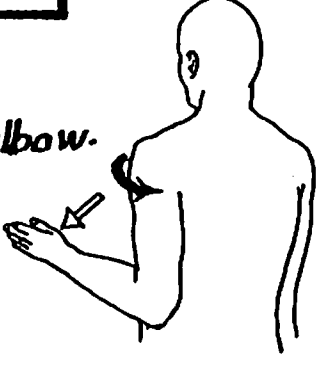
- it is the movement of taking the hand medially after flexing the elbow.
- the muscles responsible for medial rotation are :



Main medial rotators	Assistant med. rotator
(1) anterior fibres of deltoid (2) pectoralis major (3) latissimus dorsi (4) teres major	subscapularis m.
muscles inserted into the bicipital groove.	

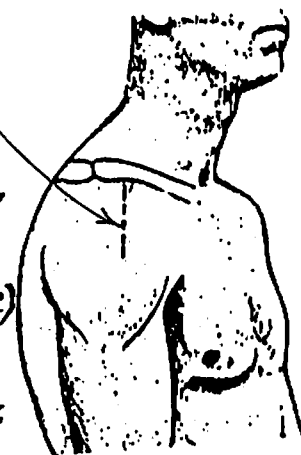
(6) Lateral rotation :

- it is the movement of taking the hand laterally after flexing the elbow.
- the muscles responsible for lat. rotation are :
 - (1) post. fibres of deltoid.
 - (2) infraspinatus.
 - (3) teres minor.



* Surface anatomy of Shoulder joint: (the joint line) :

with the arm by the side, draw a line passing 3cm vertically downwards starting just lat. to the tip of Coracoid process (below the junction between the lat. $\frac{1}{4}$ & med. $\frac{3}{4}$ of the clavicle)



* Arterial supply of shoulder joint : it is supplied by 4 aa:

- (1) ant. circumflex humeral a. (2) post. circumflex humeral a.
- (3) suprascapular artery (4) subscapular artery.

* Nerve Supply of the joint : the joint is supplied by 4 nerves

- (1) axillary nerve (2) musculocutaneous n.
- (3) Suprascapular nerve (4) lat. pectoral nerve

* Stability of the shoulder joint & its clinical importance :

1- the shoulder joint is an unstable joint for the following factors :

1-Bony factors:	2-Capsular factors:	3-Muscular Factors:
there is little fitting between the articular surfaces due to the large size of the head of humerus compared to the small shallow glenoid cavity of the scapula.	- the Capsule is lax & weak allowing separation of the articular surfaces by 2-3cm. - the ligaments supporting the Capsule are few & weak.	the inf. aspect of the joint is not supported by muscles due to the presence of the quadrangular space.

2- the most common site for dislocation of the joint is through the inf. aspect of the Capsule which is the least supported part during the raising of the arm above the head.

3- the dislocation of the head of humerus downwards into the quadrangular space may lead to injury of : (a) axillary n. (b) post. circumflex humeral a.

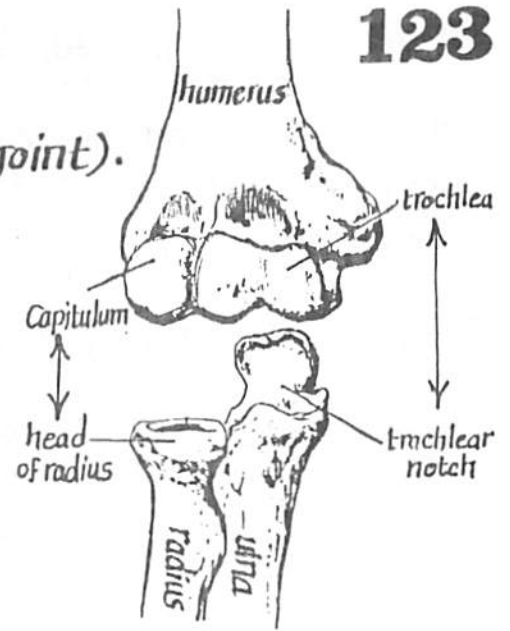
(4) ELBOW JOINT

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* Type & variety : it is synovial hinge (uniaxial joint).

* Articular surfaces:

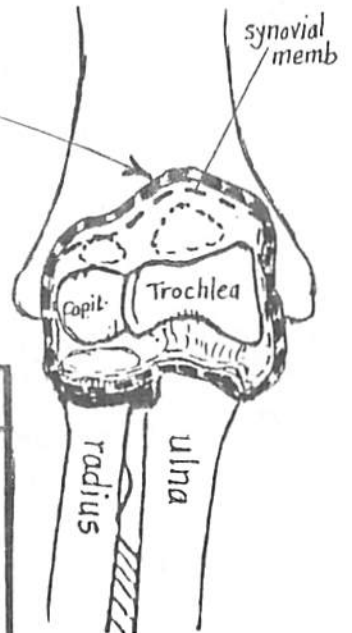
proximal articular surfaces	distal articular surfaces
the trochlea & Capitulum of the lower end of the humerus	trochlear notch of ulna the head of radius



* Fibrous capsule :

- characters : it is thin in front & behind (to allow flexion & extension) but thick at the sides (to prevent abduction & adduction)
- attachments :

Above	Below
anteriorly : it is attached to the front of the humerus just above the coronoid & radial fossae & to the roots of the med. & lat. epicondyles of humerus posteriorly : it is attached to the back of humerus just above the olecranon fossa.	it is attached to the margins of the trochlear notch of ulna & to the annular lig which surrounds the head of radius



* Synovial membrane:

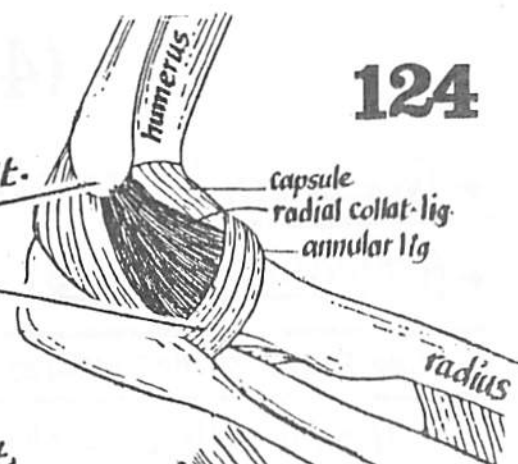
it lines the inner surface of the fibrous capsule & is reflected to cover the pads of fat filling the 3 fossae of the lower end of the humerus

* Ligaments:

As every hinge joint, the elbow joint is supported by 2 strong collateral ligaments :- the radial collateral on the lateral side &
 - " ulnar " " " medial "

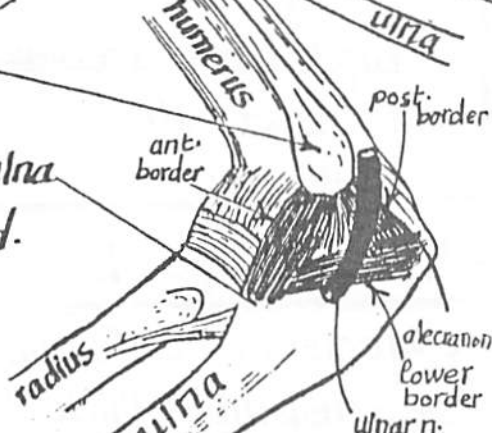
(1) the radial collateral lig. :

- It is a strong triangular lig. on the lat. side of the joint.
- its apex : is attached to the lat. epicondyle above.
- its base : " " " " annular ligament (below).



(2) the ulnar collateral lig. :

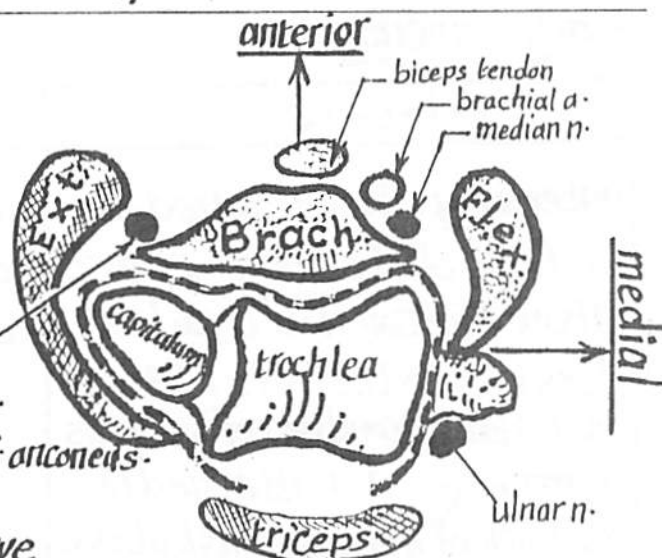
- it is a strong triangular lig. on the med. side of the joint.
- its apex (above) : is attached to the med. epicondyle.
- its ant. border : extends from the med. epicondyle to the medial border of the coronoid process of ulna.
- its post. border : extends from the med. epicondyle to the med. margin of the olecranon process.
- its lower border : extends from the coronoid process to the olecranon process.



N.B. the ulnar collateral lig. is crossed by the ulnar n. & post. ulnar recurrent a.

* Relations of the elbow joint :

- Anteriorly : the brachialis m., separating the joint from the contents of the cubital fossa i.e.
 median nerve.
 brachial artery.
 biceps tendon.
- Laterally : common extensor origin & radial n.
- Posteriorly : insertion of triceps & origin of anconeus.
- Medially : common flexor origin & ulnar nerve



* Blood Supply : from anastomosis around the elbow joint (page 80)

- * Nerve Supply : the joint is supplied by
- (1) Musculocutaneous n.
 - (2) ulnar n.
 - (3) radial n.

* Movements of the joint :

Movement	Main muscles	Assistant muscles
Flexion	(1) Brachialis (prime flexor) (2) biceps : flexor of the supinated forearm	(1) brachioradialis (2) pronator teres (3) flexor carpi radialis
Extension	Triceps	Anconeus

(5) RADIO-ULNAR JOINTS

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(A) SUPERIOR RADIOULNAR JOINT

* Type & variety : synovial, pivot.

* Articular surfaces :

(1) the circumference of the head of radius
(representing the pivot)

(2) the radial notch of ulna & the annular lig.
(representing the ring)

* The Capsule : covers the annular lig. :

- above : it is continuous with the capsule of the elbow joint.

- below : it is loosely attached to the neck of radius (so as not to interfere with its movements).

* Ligaments of the joint :

(1) Annular lig. :

- it is a strong curved lig. which forms $\frac{3}{4}$ of a circle.

- it forms, together with the radial notch of ulna, an osseo-fibrous ring around the head of the radius

- the 2 ends are attached to the ant. & post. borders of the radial notch of ulna.

- its lower border is loosely attached to the neck of radius thus closing the joint cavity inferiorly.

(2) Quadrata lig. : it is a thin quadrangular fibrous band

- it extends from the lower border of the radial notch of ulna (medially) to the neck of radius laterally, closing the joint cavity inferomedially.

N.B : the cavity of the sup. radioulnar joint is continuous with the elbow joint cavity above

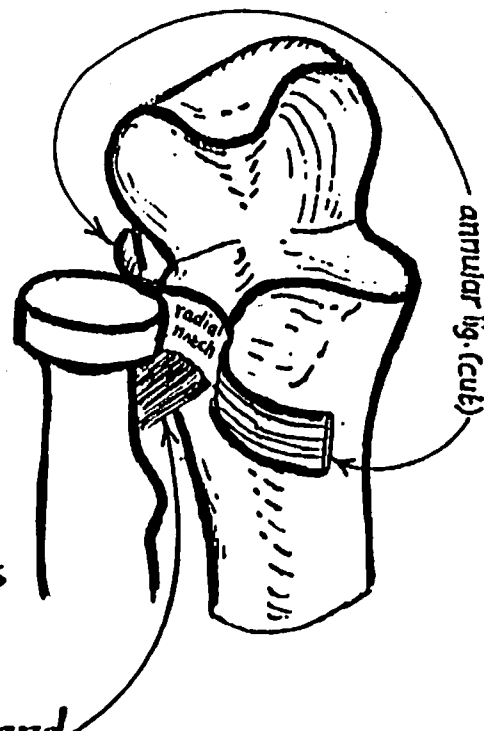
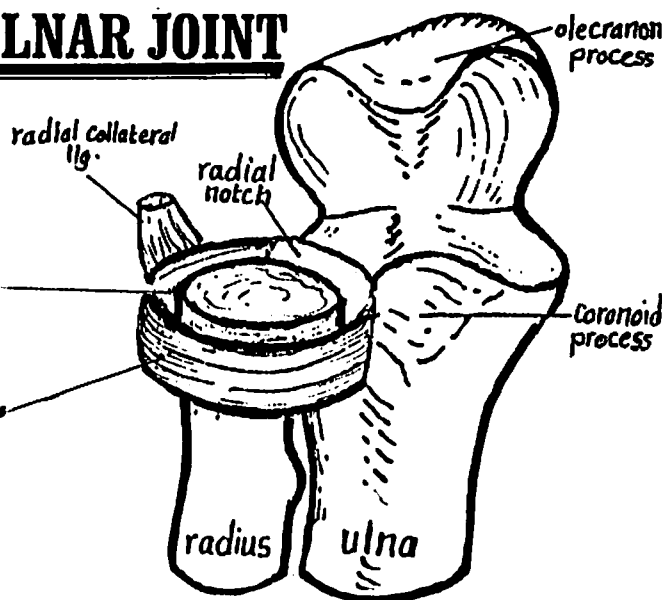
* Movements of the joint : supination & pronation (see page 127)

* Blood supply " " " : from the anastomosis around the lat. condyle (page

* Nerve supply " " " : (1) musculo-cutaneous n.

(2) median n.

(3) radial n.



(B) INFERIOR RADIOULNAR JOINT

* Articular Surfaces:

-
- A diagram of the proximal radioulnar joint. It shows the distal end of the radius and the proximal end of the ulna. The interosseous membrane is depicted as a shaded, fan-shaped structure connecting the two bones. Labels include 'interosseous memb' with an arrow pointing to the membrane, and 'head of ulna' with an arrow pointing to the proximal end of the ulna. A dashed line indicates the location of the fibrocartilage disc between the radius and ulna.

* Capsule :

- it is attached around the articular surfaces.
- it projects upwards (together with its lining synovial membrane) forming a small pouch between the radius & ulna called recessus sacciformis.

***The Articular disc: a thick triangular band of fibrocartilage**

- its apex is attached medially to the depression between the styloid process & the inf. surface of the head of ulna.
- its base is attached laterally to the lower border of the ulnar notch of the radius.
- its upper concave surface: articulates with the head of ulna.
- its lower convex surface articulates with the lunate & triquetral bone.

N.B: the articular disc separates the inf-radioulnar joint (above) from the wrist joint (below).

✓ Movements of the joint: pronation & supination. (See page 127)

* **Blood Supply**: ant. & post. interosseous arteries.

* Nerve supply: " " " " Nerves.

(C)MIDDLE RADIOULNAR JOINT

(THE INTEROSSEOUS MEMBRANE)

- it is a strong fibrous tissue membrane stretching between the interosseous borders of radius & ulna.
- it is considered a fibrous joint between the 2 bones (syndesmosis).

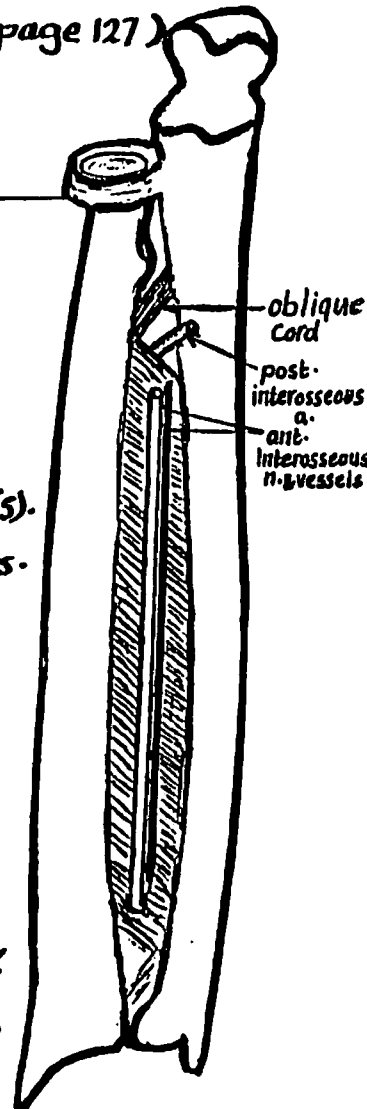
*** Attachments:** it is attached to the interosseous borders of both bones.

*** direction of fibres :**

- most of its fibres pass downwards & medially from radius to ulna.
- there are 2 or 3 oblique bands having an opposite direction, the upper one of these bands is thick & is called the **Oblique Cord**

*** Openings in the interosseous membrane:**

- (1) Above, there is a gap between the upper border of the membrane & the oblique cord for the passage of the post-interosseous a. backwards.
- (2) below, there is an opening above the lower border of the membrane for the passage of the ant-interosseous a. backwards.



* Functions of the interosseous membrane:

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- (1) it connects the moving radius to the Fixed ulna
- (2) it transmits the forces applied to the radius from the hand towards ulna & hence to the humerus.
- (3) it acts as a "check ligament" preventing upward dislocation of radius.
- (4) it provides a wide surface area for muscle attachment.

* Mechanics of the interosseous membrane:

the membrane is tense only in the midprone position (midway between pronation & supination). It is relaxed in complete pronation but slightly stretched in complete supination.

* Relations of the membrane & Muscles arising from it:

- (1) its upper border: lies 2cm below the radial tuberosity & is related to post. inteross. a.

2- Its anterior surface	3- its posterior surface
- it is related to ant. interosseous n. & vessels - it gives origin to the following muscles: (1) Flex. poll. longus: from its upper 2/3 laterally. (2) flex. digit. profundus: " " " 3/4 medially. - its lower 1/4 is covered by pronator quadratus.	- its upper part is covered by supinator m. - its middle part gives origin to 4 muscles: (1) abductor pollicis longus. (2) extensor " brevis. (3) extensor " longus (4) extensor indicis. - its lower part is related to the post. inteross. n. & the termination of ant. interosseous artery.

Movements of radioulnar joints

* The radio-ulnar joints allow only rotatory movements called **Pronation & Supination**

* Axis of rotation:

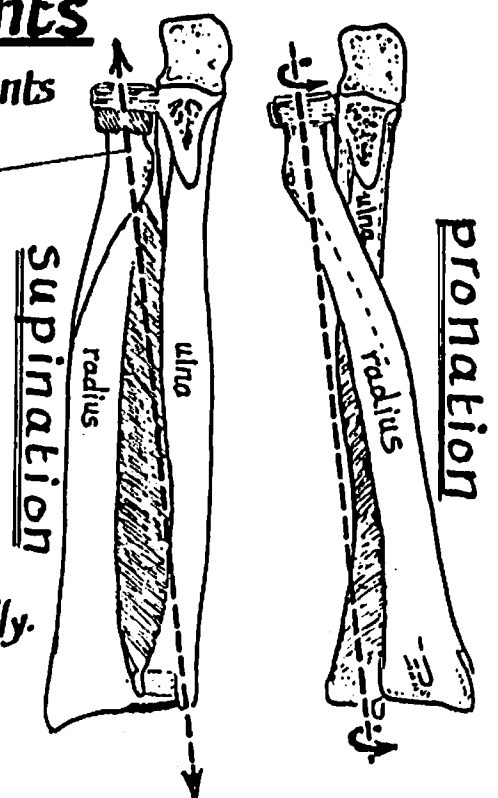
the axis around which pronation & supination take place passes from the centre of the head of radius above to the root of styloid process of ulna below.

* In the Supination movement:

- (1) the radius & ulna lie parallel to each other
- (2) the palm faces forwards & the thumb is directed laterally.

* In the pronation movement: the following occur:

- (1) the radius crosses obliquely in front of the ulna.



(2) the palm faces backwards & the thumb is directed medially.

*Muscles involved in Pronation & Supination:

Pronation	Supination
(1) It is <u>initiated</u> by <u>brachioradialis</u> (rotates the radius from full supination to the midprone position) (2) It is <u>completed</u> by : <u>pronator teres</u> & to a lesser extent by <u>pronator quadratus</u>.	(1) it is <u>initiated</u> by <u>brachioradialis</u> (rotates the radius from full pronation to the midprone position). (2) it is <u>completed</u> by : (a) <u>supinator</u> (when elbow is extended). (b) <u>biceps</u> (" " " Flexed).

(5) THE WRIST (RADIO-CARPAL) JOINT

(1) Type & variety: synovial, ellipsoid.

(2) Articular Surfaces:

(A) Superiorly (proximally): an elliptical concavity formed of the lower surface of the lower end of radius & the articular disc below the head of the ulna.

(B) Inferiorly: a convex articular surface formed of the scaphoid, lunate & triquetral bones of the proximal Carpal row.

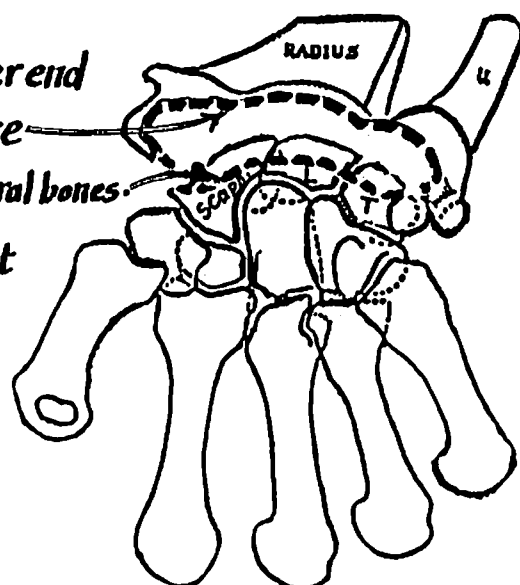
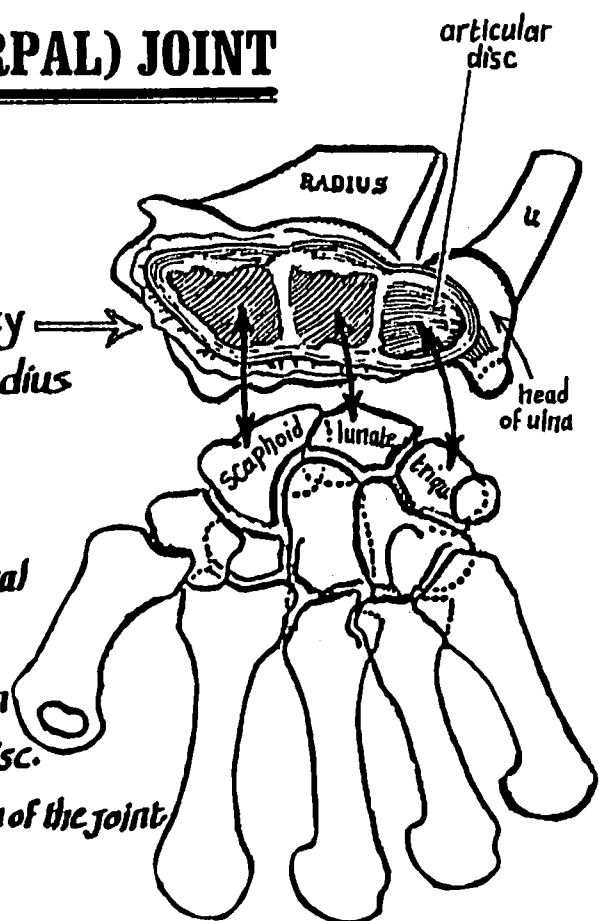
N.B: (1) the head of the ulna does not enter in the formation of the joint, being separated from it by the articular disc.
 (2) the pisiform bone also does not enter in the formation of the joint.

(3) The Fibrous Capsule:

(a) proximally, it is attached to the margins of the lower end of the radius close to the articular surface.

(b) distally, it is attached to the scaphoid, lunate & triquetral bones.

N.B: the joint cavity is shut off the inf. radioulnar joint above by the articular disc & is separated from the midcarpal joint below by the proximal row of carpal bones.



(4) Ligaments of the joint :

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(a) Ant. (palmar) radiocarpal ligament:

extends in front of the capsule from the ant.-margin of the lower end of radius & ant.-margin of the articular disc (above) to the front of scaphoid, lunate & triquetral bones (below).

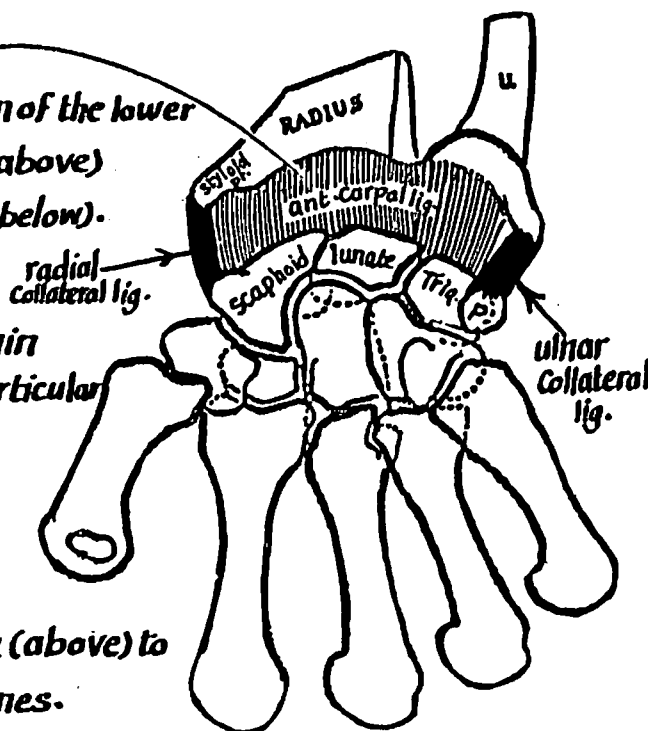
(b) post. (dorsal) radiocarpal lig.:

extends behind the capsule from the post.-margin of the lower end of radius & post.-margin of the articular disc (above) to the back of the scaphoid, lunate & triquetral bones (below).

(c) ulnar (medial) Collateral ligament:

extends from the tip of the styloid process of ulna (above) to the pisiform bone & med. side of the triquetral bones.

(d) radial (lateral) Collateral ligament : extends from the tip of the styloid process of the radius (above) to the lat.-side of the scaphoid bone (below).



(5) Relations of the joint :

Anteriorly	Posteriorly	Laterally	Medially
the contents of the Carpal tunnel	the contents of the 2nd, 3rd, 4th, 5th & 6th Compartments under the ext.-retinaculum	(1) Contents of the 1st compartment under the ext.-retinaculum (2) radial artery & dorsal digital brs. of the radial nerve. (3) beginning of the Cephalic vein.	the dorsal cubaneous branch of ulnar n.

(6) Movements of the joint :

	Main muscles	Assistant muscles
(1) Flexion	(1) Flexor carpi radialis (2) Flex. carpi ulnaris (3) Palmaris longus	(1) Fl. digit. superficialis (2) Fl. digit. profundus (3) Fl. pollicis longus.
(2) Extension	(1) Ext. carpi radialis longus (2) Ext. carpi radialis brevis (3) ext. carpi ulnaris	(1) ext. digitorum (2) ext. digiti minimi (3) ext. pollicis longus (4) ext. indicis.
(3) Abduction	(1) Flexor carpi radialis (2) ext. carpi radialis longus (3) ext. carpi radialis brevis.	(1) abductor pollicis longus. (2) extensor pollicis brevis.
(4) Adduction	(1) Flexor carpi ulnaris (2) ext. carpi ulnaris	

(7) Surface anatomy : the joint line corresponds to a transverse line connecting the styloid processes of both radius & ulna.

(8) Blood Supply : from the anastomosis around the wrist.

(9) Nerve supply : ant. & post. interosseous nerves.

(6) JOINTS OF THE HAND

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(1) Intercarpal joints: are synovial plane joints between the adjacent surfaces of the carpal bones. These joints allow slight sliding movements between the bones.

(2) Midcarpal joint: between the proximal & distal rows of the carpal bones.

- type: ellipsoid synovial joint.

- Movements allowed & muscles responsible: the same as wrist joint (mention them).

(3) Carpo-metacarpal joint of the thumb: between trapezium & base of 1st metacarpal bone.

- type: saddle synovial joint.

- Movements allowed:

(a) Flexion: by Flexor pollicis longus, flexor pollicis brevis & opponens pollicis.

(b) extension: by extensor pollicis longus, ext. pollicis brevis & abductor pollicis longus.

(c) abduction: by abductor pollicis longus & abductor pollicis brevis.

(d) adduction: by adductor pollicis.

(e) opposition: by opponens pollicis & flexor pollicis brevis.

(4) Carpo-metacarpal joints of the medial 4 fingers:

are synovial plane joints allowing slight gliding movements.

(5) Metacarpo-phalangeal (M.P.) joints:

- type: Condylloid synovial joints.

- ligaments: each joint has the following ligaments:

(a) Capsular lig.: thick in front but thin behind.

(b) palmar lig.: a strong fibrocartilagenous band in front of the joint.

(c) deep transverse metacarpal lig.: are 3 strong bands which extend transversely between the palmar ligaments of the 2nd, 3rd, 4th & 5th M.P. joints. The lumbrical mm, palmar digital nn & vessels pass in front of the deep transverse lig. while the tendons of the interosseous mm. pass behind them.

(d) med. & lat. collateral ligaments (one on each side of the joint).

- Movements allowed:

* flexion: by flexor digitorum superficialis & profundus (aided by lumbricals & interossei).

* extension: by ext. digitorum, ext. indicis & ext. digiti minimi.

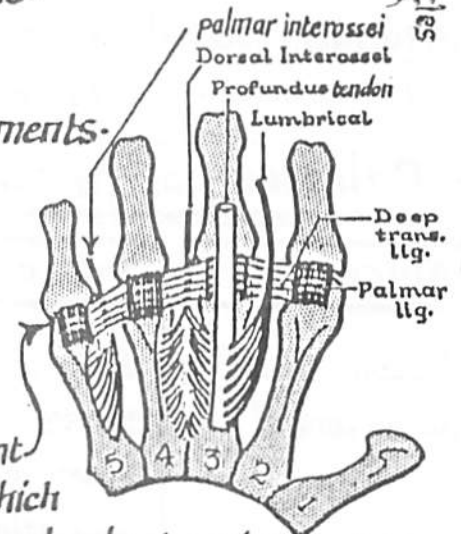
* abduction: by palmar interossei.

* adduction: by dorsal interossei.

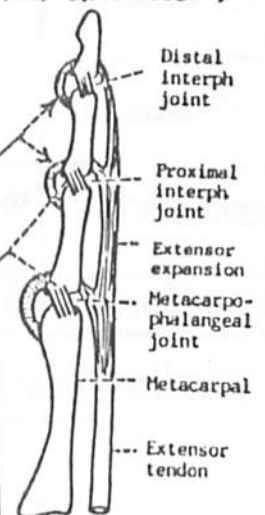
(6) Inter-phalangeal (I-P) joints: (hinge synovial joints):

- ligaments: Capsular ligaments which are reinforced by:

- Movements allowed:



revise these muscles



	proximal I-P. joint	distal I-P. joint
Flexion	Flex. digit. superficial & profundus	Flex. digit. profundus
extension	Ext. digit., ext. indicis, ext. digiti minimi, lumbricals & interossei.	

LYMPHATIC DRAINAGE OF THE U.L 131

* General Considerations:

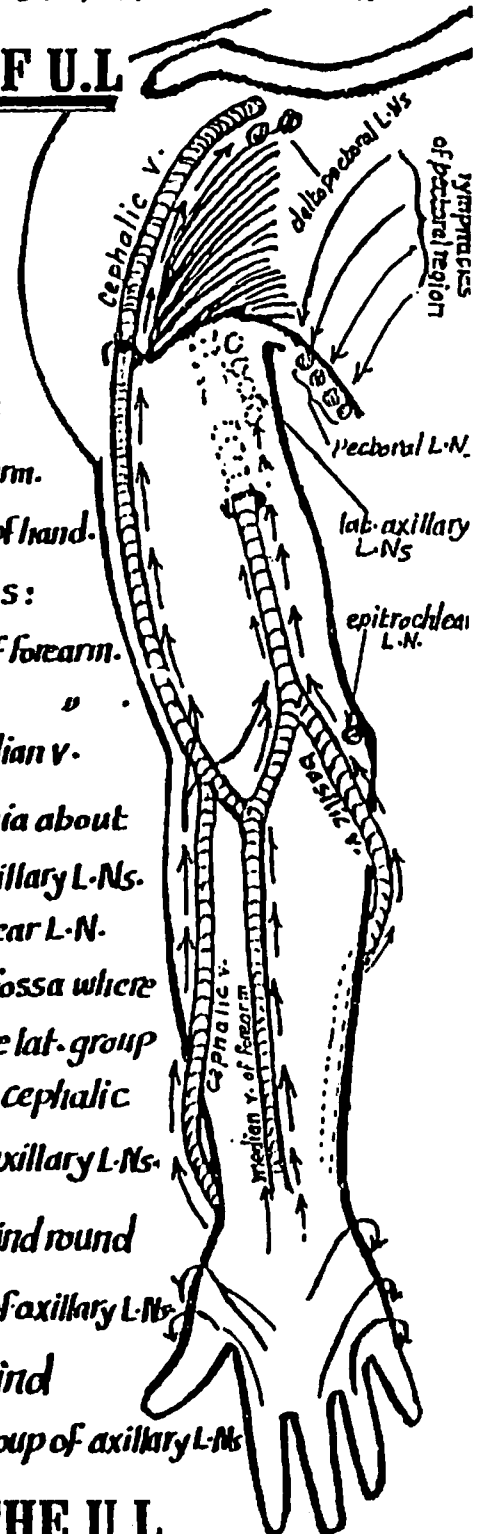
- (1) Lymph: is the excess interstitial fluid (which is filtered from the capillaries into the tissues).
- (2) Lymphatic vessels: are fine thin-walled vessels which carry the lymph back to the circulation.
They pass proximally as superficial lymphatics (accompanying superficial veins) or deep lymphatics (accompanying deep arteries) to open into a major vein near the heart.
- (3) Lymph nodes: are small bean-shaped structures lying in groups along the course of the lymphatic vessels & act as filters for the lymph before it returns to the blood circulation.

(A) SUPERFICIAL LYMPHATIC VESSELS OF U.L

— they run in the superficial fascia accompanying superficial veins:

I-lymphatics of the hand, forearm & arm:

- in the hand, the lymphatic vessels form plexuses in the skin of the fingers, palm & dorsum of the hand.
- the lymphatics of the proximal part of the palm pass to the front of the wrist then run upwards accompanying the median v. of the forearm.
- the lymphatics of the rest of the palm turn backwards to the dorsum of hand.
- the lymphatics of the dorsum of hand then run upwards as 2 groups:
 - (a) medial group: accompanying the basilic v. along the med. border of forearm.
 - (b) lateral group: " " " cephalic v. " " lat. " " "
- N.B: few lymphatics run on the front of forearm in company with the median v.
- the lymphatics accompanying the basilic v. pierce the deep fascia about the middle of the arm & proceed upwards to end in the lat-group of axillary L.Ns.
N.B: few of the lymphatics accompanying the basilic v. end in the epitrochlear L.N.
- the lymphatics accompanying the cephalic v. reach the cubital fossa where the majority of them continue upwards along the basilic v. to reach the lat-group of the axillary L.Ns while few lymphatics proceed upwards with the cephalic v. to end in the deltopectoral L.Ns then pass to the apical group of axillary L.Ns.



II-Superficial lymphatics of the pectoral region: wind round

the ant. axillary fold to end directly in the ant. (pectoral) group of axillary L.Ns.

III-Superficial lymphatics of the scapular region: wind

round the post. axillary fold to end in the post. (subscapular) group of axillary L.Ns.

(B) DEEP LYMPHATIC VESSELS OF THE U.L

- They are fewer in number than the superficial vessels. They run upwards in company with the arteries to end directly in the axillary L.Ns. (mainly the lateral group).

LYMPH NODES OF THE UPPER LIMB 132

(A) Superficial L.Ns:

(1) Supratrochlear (epitrochlear) L.Ns: 1-2 L.Ns lying just above the med. epicondyle along the basilic v. They receive afferent lymphatics from the ulnar side of the hand & forearm. They send efferent lymphatics to the lateral group of axillary L.Ns.

(2) Deltopectoral (Infraclavicular) L.Ns: 1-2 L.Ns lying just below the clavicle along the cephalic v. They receive few lymphatics accompanying this vein & send efferents to the apical group of axillary L.Ns.

(B) Deep L.Ns:

AXILLARY LYMPH NODES

They are 20-30 in number & are arranged in the axilla in 5 groups as follows :

Group	Site	receives afferent lymphatics from	Sends efferent lymphatics to
1- <u>Anterior axillary (pectoral) L.Ns.</u>	along the lower border of Pectoralis minor deep to the ant. axillary fold in relation to the lat. thoracic vessels & the axillary tail of breast	upper $\frac{1}{2}$ of the ant. wall of the trunk above the level of the umbilicus (including the breast .	to the central & apical groups of axillary L.Ns.
2- <u>posterior axillary (subscapular) L.Ns.</u>	along the lower border of subscapularis m. in close relation to the subscapular vessels	upper $\frac{1}{2}$ of the back of the trunk (from the neck above to the level of the iliac crest below).	
3- <u>Lateral axillary L.Ns.</u>	along the upper part of the humerus, closely related to the axillary V.	from the Whole upper Limb	
4- <u>Central axillary L.Ns</u>	in the upper part of the axilla closely related to the intercostobrachial n.	from the anterior, posterior & lateral groups of axillary lymph nodes.	to the apical group of axillary L.Ns.
5- <u>Apical group</u>	at the apex of the axilla alongside the upper part of axillary vein.	(a) from the above 4 groups (b) " deltopectoral L.Ns (c) directly from the breast. (d) Lymphatics from the U.L which accompany cephalic V.	(1) few efferents pass to the lower deep cervical L.Ns in the neck (2) the majority form the sub-clavian lymph trunk (see below)

The Subclavian Lymph trunk

* Origin : it is formed by the union of the efferent lymphatic vessels of the apical group of axillary L.Ns

* Termination : (1) on the left side : it joins the thoracic duct.

(2) " " right side : it joins the right lymphatic duct.

* Components: the breast includes the following components:

- (1) The Mammary gland.
- (2) The superficial fascia in which the gland is embedded (including the fibrous tissue framework & the fat which gives the breast its size particularly in females)
- (3) the overlying skin including the nipple & areola

Sex differences:

the breast is found in both sexes. It is well developed in the adult female but rudimentary in males & in females before puberty

N.B: the following description applies to the adult female breast.

* Shape: conical or hemispherical.

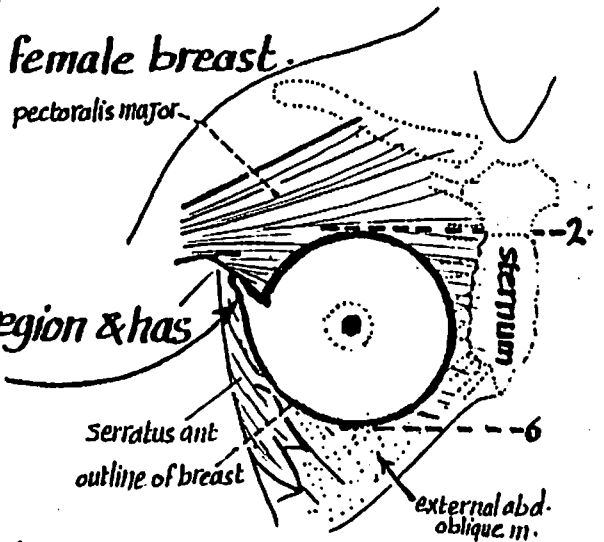
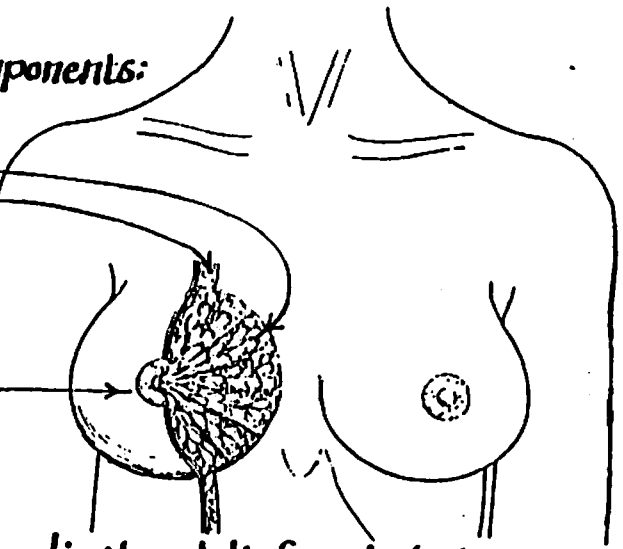
* Site & extent:

- it lies in the superficial fascia of the pectoral region & has a small extension called the axillary tail of breast

- the base of the breast extends:

- From the 2nd rib above to the 6th rib below
- from the lat. margin of the sternum medially to the midaxillary line laterally.

the axillary tail (of Spence): is a small upward extension from the upper lateral part of the gland which runs along the lower border of pectoralis major then pierces the deep fascia to reach the axilla where it lies in direct contact with the ant. (pectoral) group of axillary L.Ns.



* Deep relations: the base of the breast lies on the following structures:

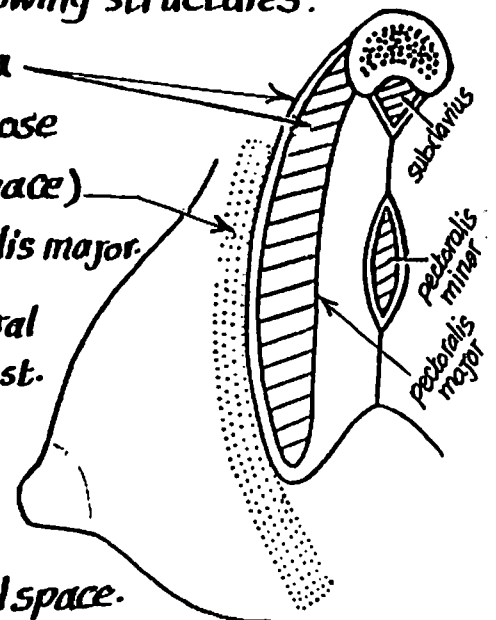
- (1) Pectoralis major m with its covering pectoral fascia

The breast is separated from the pectoral fascia by loose areolar tissue (sometimes called the retromammary space) allowing free mobility of the breast over the pectoralis major.

- (2) serratus anterior muscle
 - (3) external abdominal oblique m.
- } deep to the inferolateral 2/3 of the base of breast.

* Skin of the breast: shows the following:

- (1) the Nipple: a conical projection lying just below the centre of the breast at the level of the 4th intercostal space.



- the nipple is pierced by 15-20 lactiferous ducts & contains circular & longitudinal smooth muscle fibres which can make the nipple stiff or flat. **134**

(2) the Areola:

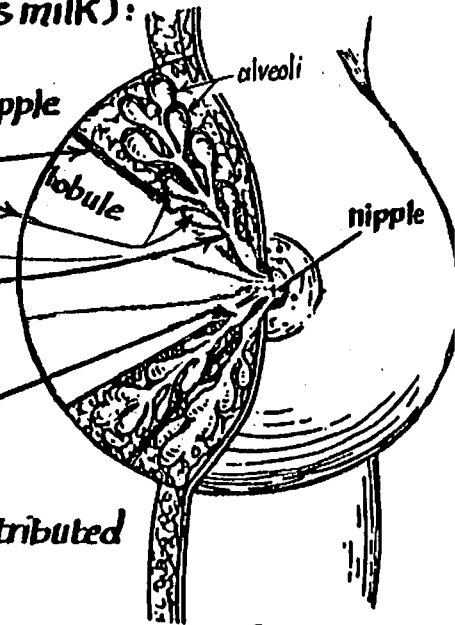
- it is a circular area of pigmented skin surrounding the base of the nipple.
- it is rich in modified sebaceous glands which become enlarged during pregnancy & lactation forming raised tubercles (of Montgomery).
- the skin of the nipple & areola is devoid of hair & has no fat beneath it.

* Internal structure of the breast :

- (a) parenchyma : glandular tissue
- (b) Stroma : supporting fibrofatty framework

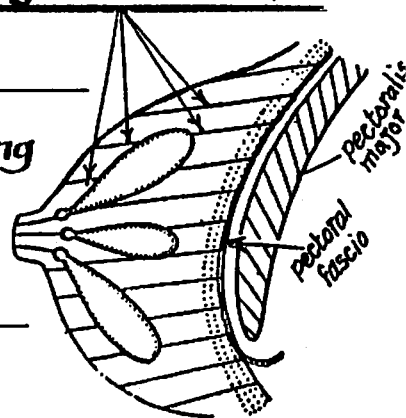
(A) the Parenchyma : (the glandular tissue which secretes milk) :

- the gland consists of 15-20 lobules converging towards the nipple
- the lobules are separated from each other by fibrous septa
- each lobule contains a cluster of alveoli (secreting units) & is drained by a lactiferous duct
- the lactiferous ducts converge towards the nipple & open on it.
- each duct has a dilatation near its end called lactiferous sinus



(B) the Stroma

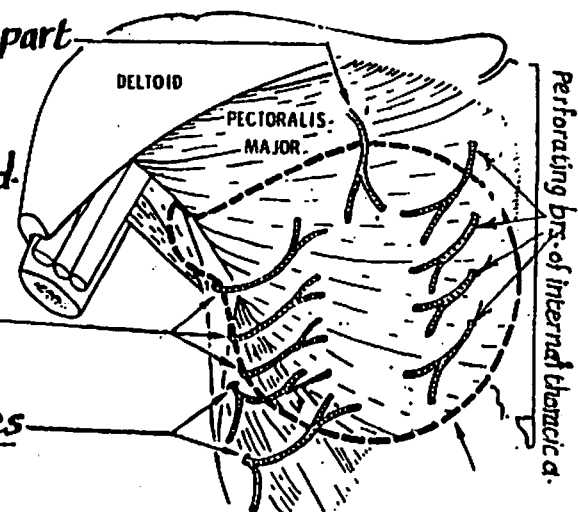
- the fatty stroma : forms the main bulk of the gland & is distributed all over the breast, except beneath the areola & nipple.
- the fibrous stroma : forms fibrous septa known as suspensory ligaments of Cooper which anchor the skin & the gland to the pectoral fascia.



N.B: the Male breast : differs from the female breast in being rudimentary & its glandular tissue consists only of ducts with no alveoli.

* Arterial Supply of the breast : it is supplied by :

- (1) pectoral br. of thoracoacromial a. : supplies the upper part
- (2) Perforating brs. of internal thoracic a. : the 2nd, 3rd & 4th branches are especially large to supply the med. part of the breast.
- (3) branches of the lateral thoracic artery supply the lateral part of the breast.
- (4) lateral branches of posterior intercostal arteries supply the lower & lat. parts of the breast.



* Venous drainage of the breast : the veins of the breast drain into: **135**

(1) the axillary v. (2) the internal thoracic v. (3) the intercostal veins.

* Nerve Supply of the breast :

it is supplied by the ant. & lat. branches of the 4th, 5th & 6th intercostal nerves which carry :

(a) sensory fibres to the skin of the breast.

(b) autonomic fibres to the smooth muscles & the blood vessels.

N.B: the nerves have no role in the secretion of milk (controlled by prolactin hormone).

LYMPHATIC DRAINAGE OF THE BREAST

A) Lymphatic Vessels : are arranged in the following 4 plexuses :

(1) subcutaneous plexus :

- drains the skin & subcutaneous tissue (except nipple & areola).
- sends efferent lymphatics to the nearby axillary L.Ns.

(2) Subareolar plexus of Sappey :

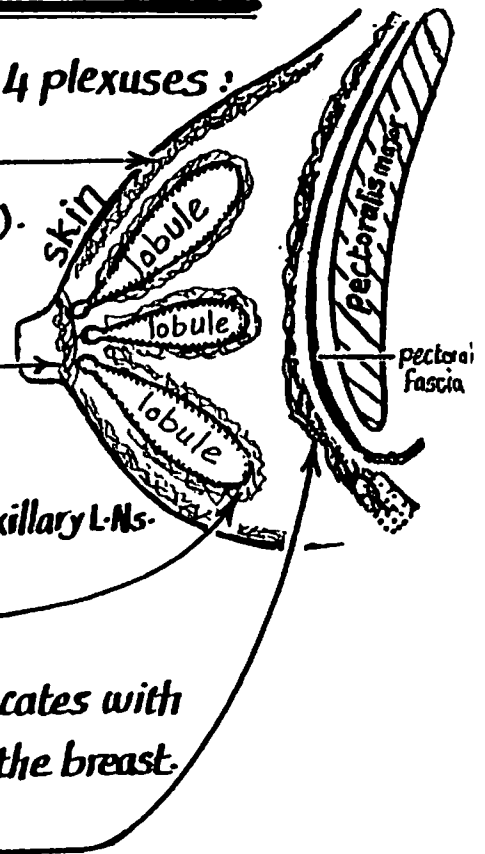
- drains the nipple, areola & parenchyma of the breast.
- sends efferent lymphatics to the pectoral & apical groups of axillary L.Ns.

(3) Perilobular (parenchymatous) plexus :

- surrounds the lobules of the mammary gland & communicates with the subareolar & the deep fascial lymphatic plexuses of the breast.

(4) Deep fascial (submammary) plexus :

- lies on the pectoral fascia covering pectoralis major.
- communicates with the perilobular & the subareolar plexuses.



(B) Lymph Nodes draining the breast :

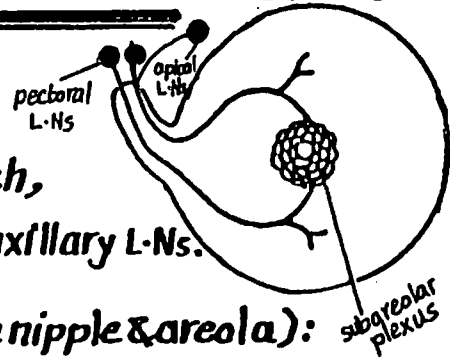
* The lymph drained by the above mentioned lymphatic plexuses is carried by lymphatic vessels to large number of lymph nodes as follows :

- 75% of the lymph drains into the axillary L.Ns (mainly the pectoral & apical groups)
- 20% " " " " " " Internal mammary L.Ns (of the same & opposite side)
- 5% " " " " " " post-intercostal, subscapular & supraclavicular L.Ns

(C) Lymphatic drainage of the different parts of the breast: 136

(1) The Nipple & areola:

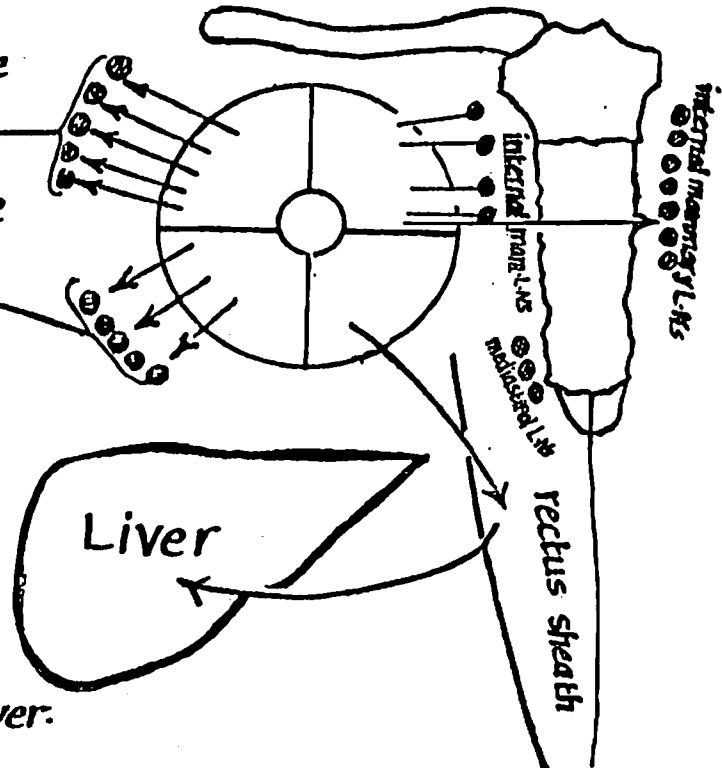
are drained by the subareolar plexus of Saby from which, lymphatics pass directly to the pectoral & apical groups of axillary L.Ns.



(2) The Skin & subcutaneous tissue (excluding the nipple & areola):

are drained by the subcutaneous plexus, from which lymphatics radiate to the periphery to drain into adjacent L.Ns as follows:

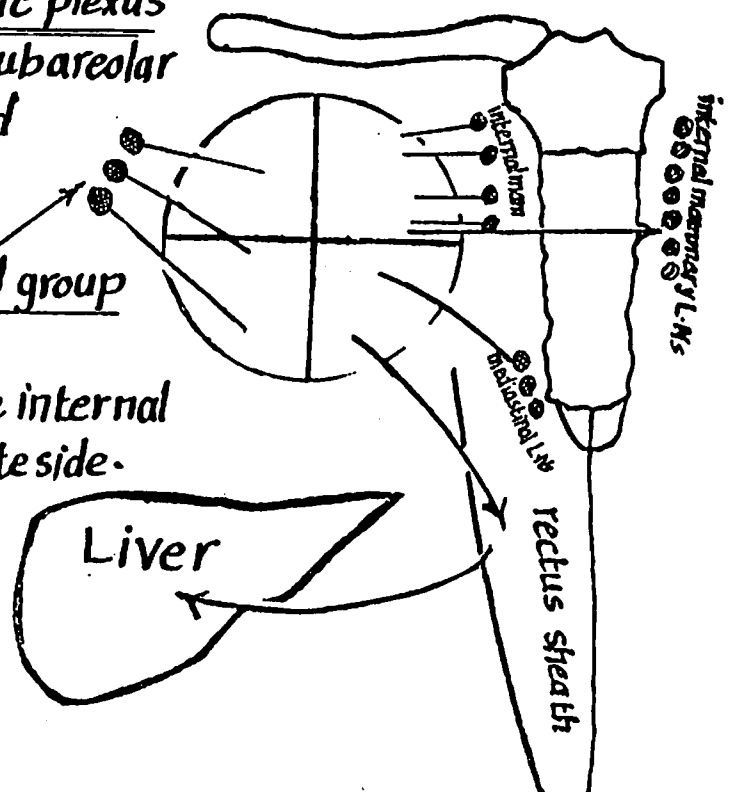
- (a) the upper lateral quadrant drains into the pectoral group of axillary L.Ns
- (b) the lower lateral quadrant drains into the subscapular group of axillary L.Ns
- (c) the upper med. quadrant drains into the internal mammary (internal thoracic) L.Ns of the same side but some lymphatics cross to the opposite side.
- (d) the lower med. quadrant drains into the mediastinal L.Ns, some lymphatics pass through the rectus sheath to reach the liver.



(3) The breast Parenchyma:

is drained by the perilobular lymphatic plexus which communicates freely with the subareolar & the deep fascial plexuses & is drained into the adjacent L.Ns. as follows:

- (a) the lat. 1/2 drains mainly into the pectoral group of axillary L.Ns
- (b) the upper med. part drains into the internal mammary L.Ns of the same & opposite side.
- (c) the lower med. part drains into the mediastinal L.Ns & the liver.



OSSIFICATION OF THE BONES OF THE U.L 137

(1) Clavicle:

* It is the first bone in the body to ossify (in the 5th week of intrauterine life).

* It ossifies in membrane except its medial end which ossifies in cartilage.

* Ossification Centres : it ossifies from 3 centres :

(a) two 1st y ossification centres for the shaft (fuse together in the 7th week).

(b) one 2nd y ossification centre for the med. end : appears at the age of 15 - 17 years
& fuses with the shaft at the age of 21-22 years.

N.B: the clavicle is the only long bone which  ossifies in membrane
has 2 primary centres of ossification

(2) Scapula: ossifies in cartilage from 8 centres (1st y & 7th y) as follows :

- one 1st y centre for the body (appears near the glenoid cavity in the 8th week).

- 2 2nd y centres for the coracoid process (one in the middle & one in the root of the process).

- 2 2nd y centres for the acromion process.

- one 2nd y centre for the medial border.

- " " " " " inferior angle.

- " " " " " lower 2/3 of the margin of glenoid cavity.

(3) Humerus: ossifies in cartilage from 8 centres (1st y & 7th y) as follows :

(a) one 1st y centre for the shaft (appears in its middle during the 8th week).

(b) 3 2nd y centres for the upper end :  (1) one for the head (1st year)
(2) " " " greater tuberosity (2nd year).
(3) " " " lesser tuberosity (5th ").

(c) 4 2nd y centres for the lower end :  (1) one for the capitulum (1st year).
(2) one " med. part of the trochlea (10th year).
(3) " " med. epicondyle (6th year).
(4) " " lat. epicondyle (12th year).

(4) Radius: ossifies in cartilage from 3 centres (one 1st y & 2 2nd y) :

(a) one 1st y centre for the shaft (appears in its middle during the 8th week).

(b) one 2nd y centre " " lower end (appears by the end of the 1st year)

(c) one 2nd y centre " " upper end (" " the 5th year).

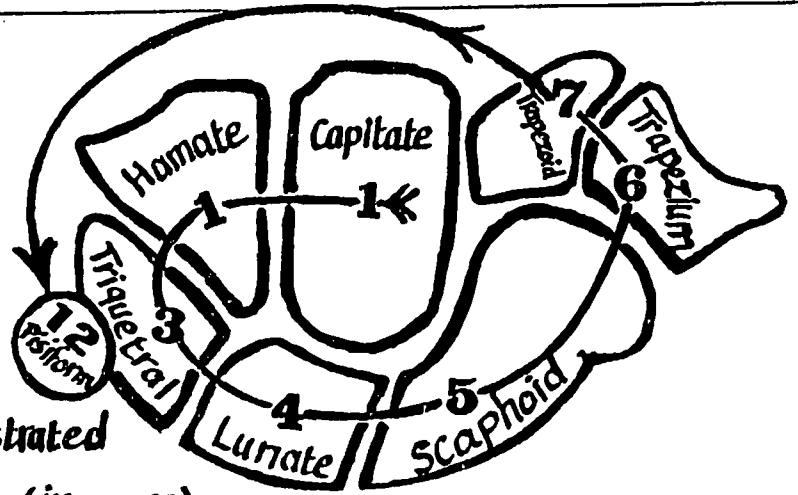
5- ulna : ossifies in cartilage from 3 Centres (one 1^{ry} & 2 2^{ry}) as follows:

- (a) one 1^{ry} centre for the shaft (appears in its middle in the 8th week).
- (b) one 2^{ry} centre for the lower end (appears in the 5th year).
- (c) one 2^{ry} centre " " upper end (olecranon) : appears in the 10th year.

6- Bones of the hand:

I- Carpal bones:

- all bones are cartilagenous at birth.
- each bone ossifies from one centre of ossification appearing after birth
- the sequence of ossification is illustrated in the diagram in approximate ages (in years).



N.B : the Capitate is the 1st bone to ossify (1st year) while Pisiform is the last (12 years).

II- Metacarpal bones : ossify in cartilage as follows :

(a) the 1st metacarpal bone (of the thumb) ossifies, like a phalanx, from

- (1) a 1^{ry} centre for the shaft (2) a 2^{ry} centre in the base.

(b) each of the remaining 4 metacarpals : ossifies from

- (1) a 1^{ry} centre for the shaft (2) a 2^{ry} centre in the head (not the base).

III- The phalanges : each phalanx ossifies in cartilage from 2 centres :

- (a) a primary centre for the shaft (8th week).
- (b) a secondary centre in the base (2nd year).

The growing ends of the bones of U.L

- (A) in the humerus : the upper end
- (B) in the radius & ulna : their lower ends.

